APPLETONS'
POPULAR SCIENCE
MONTHLY.

OCTOBER, 1897.

THE RACIAL GEOGRAPHY OF EUROPE.

A SOCIOLOGICAL STUDY.

(*Lowell Institute Lectures, 1896.*)

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IX.—ITALY.

THE anthropology of Italy has a very pertinent interest for the historian, especially in so far as it throws light upon the confusing statements of the ancients. Pure natural science, the morphology of the genus *Homo*, is now prepared to render important service in the interpretation of the body of historical materials which has long been accumulating. Happily, the Italian Government has assisted in the good work, with the result that our data for that country are extremely rich and authentic.* The anthropological problems presented are not as complicated as in France, for a reason we have already noted—namely, that in Italy, lying as it does entirely south of the great Alpine chain, we have to do practically with two instead of all three of the European racial types. In other words, the northern Teutonic blond race is debarred by the Alps. It does appear in a few places, as we shall take occasion to point out, but its influence is comparatively small. This leaves us, therefore, with two rivals

* The best authority upon the living population is Dr. Ridolfo Livi, Capitano Medico in the Ministero della Guerra at Rome. To him I am personally indebted for invaluable assistance. His admirable Antropometria Militare, Rome, 1896, with its superb atlas, must long stand as a model for other investigators. Titles of his other scattered monographs will be found in the author's Bibliography of the Ethnology of Europe, shortly to appear in a Bulletin of the Boston Public Library. Among other references of especial value on

for supremacy—viz., the broad-headed Alpine type of central Europe and the true Mediterranean race in the south.

A second reason, no less potent than the first, for the simplicity of the ethnic problems presented in Italy is, of course, its peninsulated structure. All the outlying parts of Europe enjoy a similar isolation. The population of Spain is even more unified than the Italian. The former is probably the most homogeneous in Europe, being almost entirely recruited from the Mediterranean long-headed stock. So entirely similar, in fact, are all the peoples which have invaded or, we had better say, populated the Iberian Peninsula that we are unable to distinguish them anthropologically one from another. The Spaniards are akin to the Berbers in Morocco, Algiers, and Tunis. The division line of races falls at the French-Spanish frontier, as the maps in our last article on the Basques showed in detail. "Beyond the Pyrenees begins Africa" indeed. In Italy a corresponding transition from Europe to Africa takes place, more gradually perhaps but no less surely. It divides the Italian nation into two equal parts, of entirely different racial descent.

Geographically, Italy is constituted of two distinct parts. The basin of the Po, between the Apennines and the Alps, is one of the best defined areas of characterization in Europe. The only place in all the periphery where its boundary is indistinct is on the southeast, from Bologna to Pesaro. Here, for a short distance, one of the little rivers which comes to the sea by Rimini, just north of Pesaro, is the artificial boundary. It was the Rubicon of the ancients, the frontier chosen by the Emperor Augustus between Italy proper and cisalpine Gaul. The second half of the kingdom, no less definitely characterized, lies south of this line in the peninsular portion. Here is where the true Italian language in purity begins, in contradistinction to the Gallo-Italian in the north, as Biondelli long ago proved. The boundaries of this half are clearly marked on the north along the crest of the Apennines, away across to the frontier of France; for the modern provinces of Liguria (see map) belong in flora and fauna, and, as we shall show, in the character of their population, to the southern half

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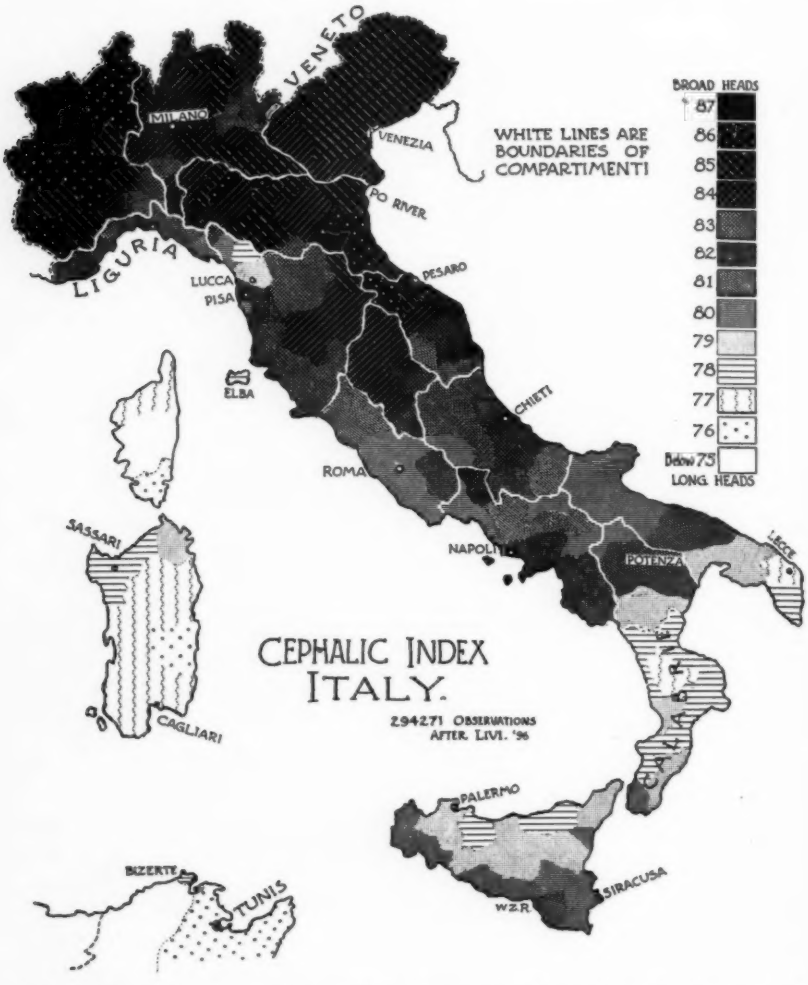
Italy are: G. Nicolucci, Antropologia dell' Italia nel evo antico e nel moderno, in Atti del R. Accademia delle Scienze di Napoli, series 2 a, ii, 1888, No. 9, pp. 1–112; G. Sergi, Liguri e Celti nella valle del Po, in Archivio per l'Antropologia, xiii, 1883, pp. 117–175, gives a succinct account of the several strata of population; R. Zampa, Sull' etnografia storica ed antropologica dell' Italia, Atti del Accademia pontificia dei Nuovi Lincei, Rome, xliv, session May 17, 1891, pp. 173 *seq.*; and ibid., Crania Italica vetera, Memorie Accad. pont. dei Nuovi Lincei, vii, 1891, pp. 1–73. Full references to the other works of these authors, as well as of Calori, Lombroso, Helbig, Fligier, Virchow, *et als.*, will be found in the author's bibliography above mentioned. Broca, in reviewing Nicolucci's work in Revue d'Anthropologie, 1874, gives a good summary of conclusions at that time, before the more recent methods of research were adopted.

of the country. It is this leg of the peninsula which alone was called Italy by the ancient geographers; or, to be more precise, merely the portion south of Rome. Only by slow degrees was the term extended to cover the basin of the Po. The present political unity of all Italy, real though it be, is of course only a recent

and, in a sense, an artificial product. It should not obscure our vision as to the ethnic realities of the case.

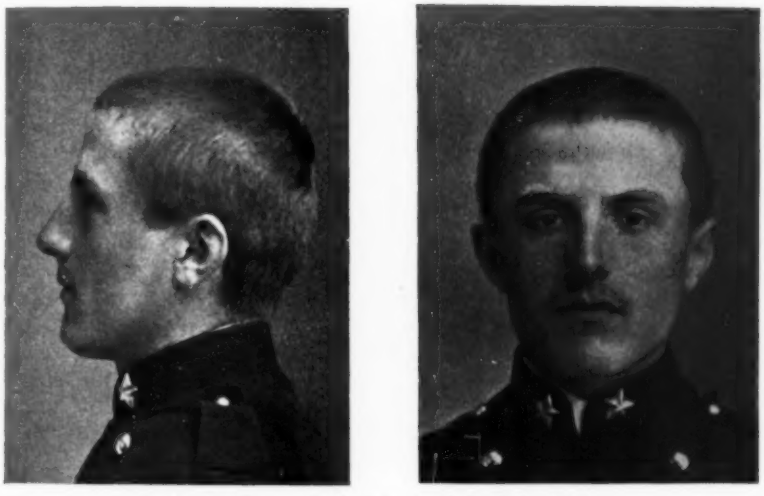
The topography and location of these two halves of the kingdom of Italy which we have outlined have been of profound significance for their human history. In the main distinct politically, the ethnic fate of their several populations has been widely different. In the Po Valley, the "cockpit of Europe," as Freeman termed it, every influence has been directed toward intermixture. Inviting in the extreme, especially as compared with the transalpine countries, it has been incessantly invaded from three points of the compass. The peninsula, on the other hand, has

been much freer from ethnic interference, especially in the early days when navigation across seas was a hazardous proceeding. Only in the extreme south do we have occasion to note racial



invasions along the coast. The absence of protected waters and especially of good harbors, all along the middle portion of the peninsula has not invited a landing from foreigners. Open water ways have not enabled them to press far inland, even if they disembarked. These simple geographical facts explain much in the anthropological sense. They meant little after the full development of water transportation, because thereafter travel by sea was far simpler than by land. Our vision must, however, pierce the obscurity of early times before the great human invention of navigation had been perfected.

In order to give a summary view of the physical characteristics of the present population which constitutes the two halves of Italy above described, we have reproduced upon the following pages the three most important maps in Livi's great atlas. Based as they are upon detailed measurements made upon nearly three hundred thousand conscripts, they can not fail to inspire confidence in the evidence they have to present. Especially is this true since their testimony is a perfect corroboration of the scattered researches of many observers since the classical work of Calori and Nicolucci thirty years ago. Researches at that time made upon crania collected from the cemeteries and crypts began to indicate a profound difference in head form between the populations of north and south. Then later, when Zampa, Lombroso, Pagliani, and Riccardi * took up the study of the living peoples, they revealed equally radical differences in the pigmentation and stature. It remained for Livi to present these new data, uniformly collected from every commune in the kingdom, to set all possible doubts at rest. It should be observed that our maps are all uniformly divided by white boundary lines into *compartimenti*, so called. These administrative districts correspond to the ancient historical divisions of the kingdom. Their names are all given



ALPINE TYPE. Piedmont. Cephalic Index, 91·3.

upon our preceding map of physical geography. Being similar through the whole series, they facilitate comparisons between smaller districts in detail.

The basin of the Po is peopled by an ethnic type which is mani-

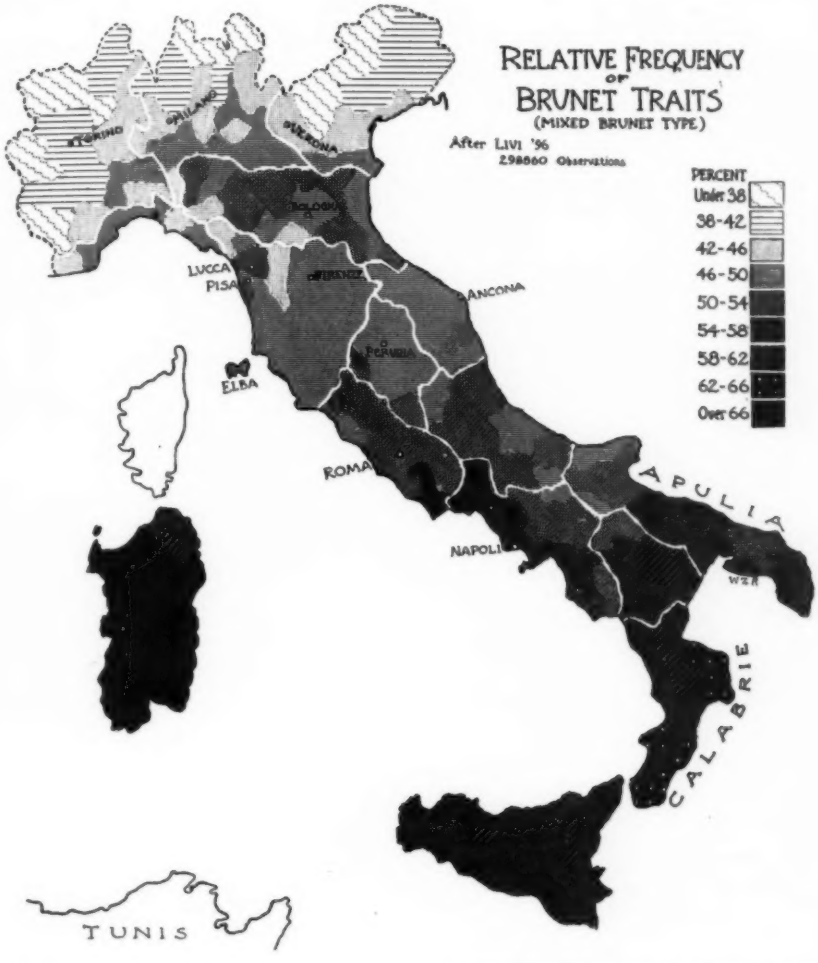
* Exhaustive bibliography of each of these writers will be found in the Bulletin of the Boston Public Library, mentioned in the note on a preceding page.

festly broad-headed. This Alpine racial characteristic is intensified all along the northern frontier. In proportion as one penetrates the mountains this phenomenon becomes more marked. It culminates in Piedmont along the frontier of France. Here, as we have already shown in our general map of Europe, is the purest representation of the Alpine race on the continent. Dr. Livi has photographed a recruit from this region for me. It is reproduced upon this page. The rounded fullness at the forehead and the shortness of head from front to back can not fail of notice. Across the frontier, in French Savoy, the same racial type is firmly intrenched in the high Alps. Such is also the prevalent physical type of the Swiss, who are descendants of the Rhætians of Roman times. Still further back we come upon the prehistoric lake dwellers. No change of race has here taken place since very early times. All indications point to a primitive occupation and a persistent defense of the Alpine highland by this broad-headed racial type.*

This Alpine type in northern Italy is the most blond and the tallest in the kingdom. This, of course, does not imply that these are really a blond and tall people. Compared with those of our own parentage in northern Europe, these Italians appear to be quite brunette; hair and eyes in our portrait type were classed as light chestnut. Standing in a normal company of Piedmontese, an Englishman could look straight across over their heads; for they average three to five inches less in bodily stature than we in England or America; yet, for Italy, they are certainly one of its tallest types. The traits we have mentioned disappear in exact proportion to the accessibility of the population to intermixture. The whole immediate valley of the Po, therefore, shows a distinct attenuation of each detail. We may in general distinguish such ethnic intermixture from either of two directions: from the north it has come by the influx of Teutonic tribes across the mountain passes; from the south, by several channels of communication across or around the Apennines from the peninsula. For example, the transition from Alpine broad heads in Emilia to the longer-headed population over in Tuscany near Florence is rather

* Whether this brachycephalic population is to be identified historically with the "Ligurians" or not is still matter of earnest dispute. Nicolucci, Calori, and most foreign authorities answer it affirmatively. On the other hand, such eminent specialists as Livi, Sergi, and Zampa agree in tracing the Ligurians back to a still more primitive and underlying stratum of population. This original stock was dolichocephalic, identical with the Mediterranean type in the south. Its direct descendants and survivors are the people of the modern province of Liguria, to be described shortly. These latter writers hold the broad headed more recent overlying people to be the true Celtic invaders from the Alps. Whichever theory be correct, we may rest assured of the ethnic facts in the case. There is no longer doubt of the two distinct strata. To christen them is a relatively unimportant matter, from our point of view.

sharp, because the mountains here are quite high and impassable, save at a few points. On the east, however, by Pesaro, where natural barriers fail, the northern element has penetrated farther to the south. It has overflowed into Umbria, Tuscany, and Marche, being there once more in possession of a congenial moun-

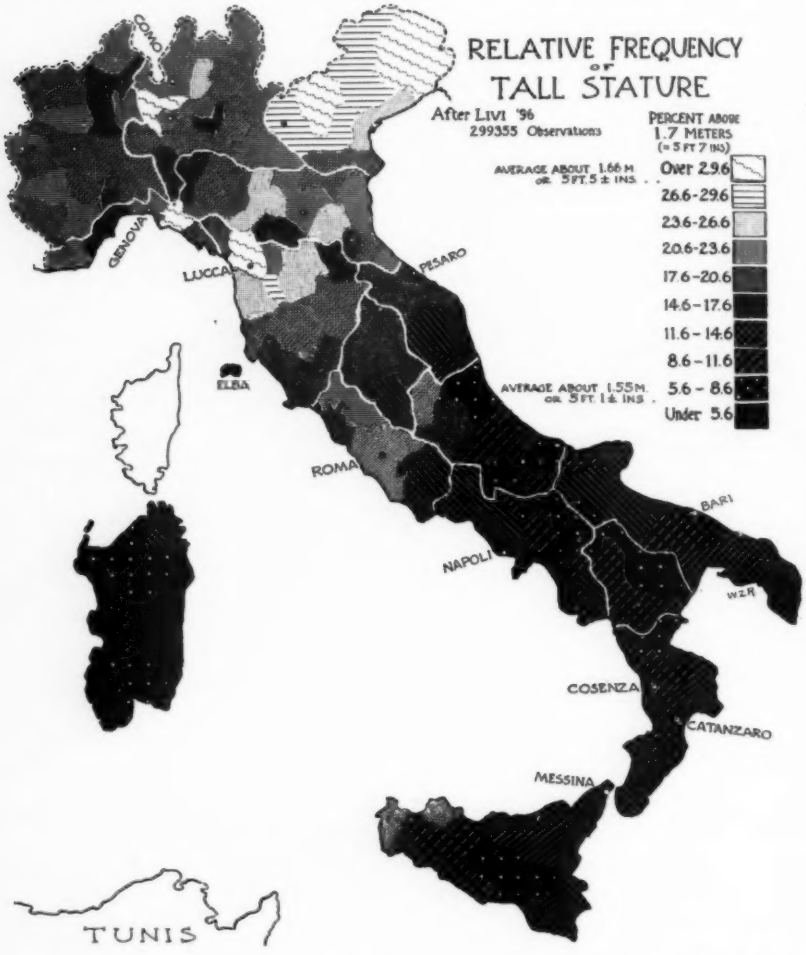


tainous habitat.* The same geographical isolation which, as Symonds asserts, fostered the pietism of Assisi, has enabled this northern type to hold its own against aggression from the south.

It is rather interesting to note the prevalence of the brachycephalic Alpine race in this mountainous part of Italy; for nowhere else in the peninsula proper is there any evidence of that

* *Vide*, on the Umbrians, Zampa, in Archivio per l'Antropologia, xviii, 1888, pp. 175 *et seq.*; and Memorie Accademia pontificia dei Nuovi Lincei, Rome, 1889, pp. 111 *et seq.*

differentiation of the populations of the plains from those of the mountains which we have noted in other parts of Europe. Nor is a reason for the general absence of the phenomenon hard to find. If it be, indeed, an economic and social phenomenon, dependent upon differences in the economic possibilities of any



given areas, there is little reason for its appearance elsewhere in Italy; for the Apennines do not form regions of economic unattractiveness, as their geology is favorable to agriculture, and their soil and climate are kind. In many places they are even more favorable habitats than the plains, by reason of a more plentiful rainfall. The absence of anthropological contrasts coincident with a similar absence of economic differences is, in fact, a point in favor of our hypothesis.

Are there any vestiges in the population of northern Italy of

that vast army of Teutonic invaders which all through the historic period and probably since a very early time has poured over the Alps and out into the rich valley of the Po? Where are those gigantic, tawny-haired barbarians described by the ancient writers who came from the far country north of the mountains? Even of late there have been many of them—Cimbri, Goths, Ostrogoths, Visigoths, Saxons, Lombards. Historians are inclined to overrate their numerical importance as an element in the present population. On the other hand many anthropologists, Virchow for example, have asserted that these barbarian invaders have completely disappeared from sight in the present population. Truth lies intermediate between the two. It is, of course, probable that ancient writers exaggerated the numbers in the immigrant hordes. Modern scholars estimate their numbers to be relatively small. Thus Zampa* holds the invasion of the Lombards to have been the most considerable numerically, although their forces did not probably exceed sixty thousand, followed perhaps by twenty thousand Saxons. Eighty thousand immigrants in the most thickly settled area in ancient Europe surely would not have diluted the population very greatly. We can not expect too much evidence in this direction consequently, although there certainly is some. The relative purity of the Piedmont Alpine type compared with that of Veneto is probably to be ascribed to its greater inaccessibility to these Teutons. Wherever any of the historic passes debouch upon the plain of the Po there we find some disturbance of the normal relations of physical traits one to another; as, for example, at Como, near Verona, and at the mouth of the Brenner in Veneto. The clearest indubitable case of Teutonic intermixture is in the population of Lombardy about Milan. Here, it will be observed on our maps, is a distinct increase of stature; the people are at the same time relatively blond. The extreme broad-headedness of Piedmont and Veneto is moderated. Everything points to an appreciable Teutonic blond. This is as it should be. Every invading host would naturally gravitate toward Milan. It is at the focus of all roads over the mountains. Ratzel, in his Anthropo-Geographie, has contrasted the influence exerted by the trend of the valleys on the different slopes of the Alps. Whereas in France they all diverge, spraying the invaders upon the quiescent population; in Italy all streams seem to concentrate upon Lombardy.† The ethnic consequences are apparent there, perhaps for this reason.

* Les Gaulois d'Italie, in Mem. pont. Accad. di Nuovi Lincei, Rome, viii, 1892, pp. 241–316.

† On the significance of the Alpine passes, *vide* Lentheric, Les Alpes devant l'Homme; also Jahresbericht des Vereins für Erdkunde zu Dresden, xviii.

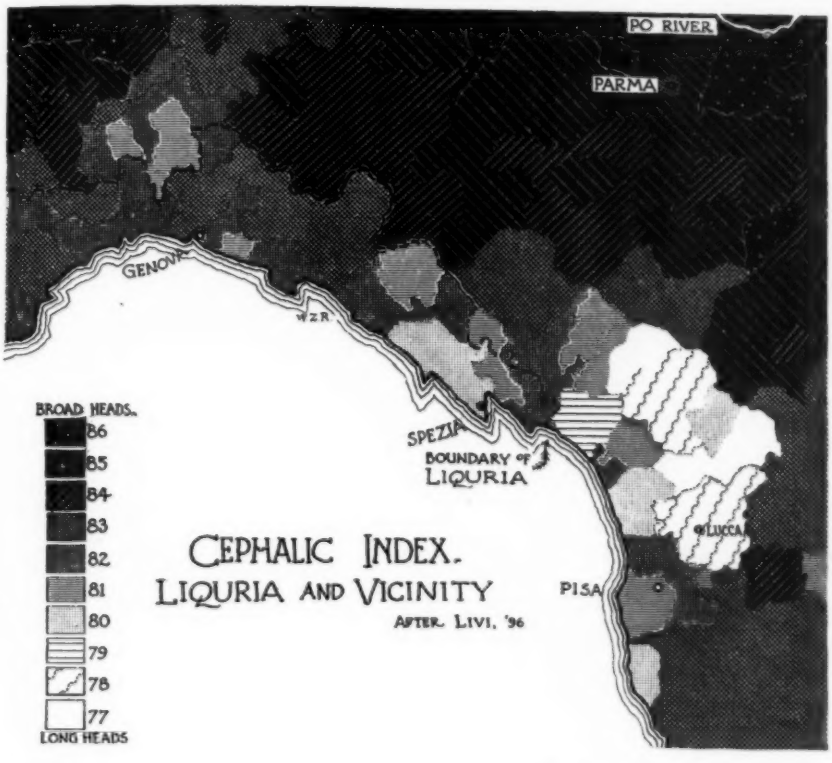
With the exception of Lombardy the blood of the Teutonic invaders in Italy seems to have been diluted to extinction. Notwithstanding this, it is curious to note that the German language still survives in a number of isolated communities in the back waters of the streams of immigration. Up in the side valleys along the main highways over the Alps are still to be found German customs and folklore as well. The peasants, however, are not to be distinguished physically at this present day from their true Italian-speaking neighbors. These southern Alps are also places of refuge for many other curious *membra disjecta*. Mendini, for example, has studied in Piedmont, with some detail, a little community of the Valdesi, descendants of the followers of Juan Valdès, the mediæval reformer. Here they have persisted in their heretical beliefs despite five hundred years of persecution and ostracism. In this case mutual repulsion seems to have produced real physical results, as the people of these villages seem to differ quite appreciably from the Catholic population in many important respects.

The ethnic transition from the Alpine race in the Po Valley to the Mediterranean race in Italy proper is particularly sharp along the crest of the Apennines from the French frontier to Florence. The population of modern Liguria, the long, narrow strip of country between the mountains and the Gulf of Genoa, is distinctly allied to the south in all respects. Especially does the Mediterranean long-headedness of this region appear upon both of our maps of cephalic index. It is curious to note how the sharpness of the ethnic boundary is softened where the physical barriers against intercourse between north and south are modified. Thus there is just north of Genoa a decided break in the distinct racial frontier of the province; for just here is, as our topographical map of the country indicates, a broad opening in the mountains leading over to the north. The pass is easily traversed by rail to-day. Over it many invasions in either direction have served to confound the populations upon either side.

The individuality of the modern Ligurians culminates in one of the most puzzling ethnic patches in Italy, viz., the people of the district about Lucca, in the northwest corner of Tuscany. Consideration of our maps will show the strong relief with which these people stand forth from their neighbors. These peasants of Garfagnana and Lucchese seem to set all ethnic probabilities at naught. They are as tall as the Venetians or any of the northern populations of Italy, yet in head form they are closely allied to the people of the extreme south. They are among the longest-headed in all the kingdom. They seem also to be considerably more brunette than any of their neighbors. Nor are these pecul-

iarities of modern origin; certainly not their stature, at all events. For Strabo tells us that the Romans were accustomed to recruit their legions here because of the massive physique of the people.

In order to make the reality of this curious patch more apparent, we have reproduced in our small map on this page a bit of the country in detail. It shows how suddenly the head form changes at the crest of the Apennines as we pass from the Po valley to the coast strip of Liguria. As we leave the river and rise slowly across Emilia toward the mountain range the heads



gradually become less purely Alpine: and then suddenly as we cross the watershed we step into an entirely different population. On the southern edge this little spot of Mediterranean long-headedness terminates with almost equal sharpness, although geographical features remain quite uniform. This eliminates environment as an explanation for the phenomenon; we must seek the cause elsewhere.

All sorts of explanations for the peculiarities of this ethnic spot about Lucca have been presented. Lombroso, who first discovered its tall stature, inclines to the belief that here is a last relic of the ancient and long-extinct Etruscan people penned in

between some of the highest mountains in Italy and the sea. He holds that they were here driven to cover in this corner of Tuscany by the developed Roman power in the south. Dr. Beddoe gives another explanation which is interesting. He believes this population to be the result of artificial colonization. Livy tells us that the Romans at one time, in pursuance of a long-settled policy, transported forty thousand Ligurians (?) to Samnium, filling their places with others from the south. If this artificial transplanting had been effected a sufficient number of times; if the Liguria of Livy had surely been this modern one instead of the Alpine ancient one; and thirdly, if we could thus account for the tallness of stature, certainly not of southern origin, we might place more reliance upon this ingenious hypothesis. As it is we can not think it far reaching enough. To us it seems more likely that we have to do rather with a population highly individualized by geographical isolation. Much of the region is very fertile; it is densely populated; it is closely bounded by mountain and sea. May it not contain a remnant of a more ancient people than others roundabout? This accords with both Sergi's and Livi's view. At a later time we shall be able to prove that in many respects the oldest, most primitive layer of population in Italy possessed many of these peculiar traits of the Garfagnanans and Luccheser. We incline to the belief that a bit of this primitive substratum has persisted in this place. The people of the island of Elba off the coast are quite similar to it. Insularity explains their peculiar physical traits. Why not environmental isolation about Lucca as well?

One of the most disputed points in the ethnological history of Europe concerns the origin of the ancient Etruscans, who dominated middle Italy a thousand years or more before the Christian era. Ancient Etruria covered what is now made up of the two compartimenti of Toscana and Roma—extending, that is to say, from the Arno to the Tiber. Here we find a sub-area of characterization, rich alike in soil and climate, somewhat isolated from the rest of the peninsula. This district is the center of one of the earliest highly evolved cultures in Europe. The Etruscans appear suddenly upon the scene, invading the territory of the Umbrians, who seem to have been indigenous to the soil, akin to the Oscians, Italians (Vituli), and other native peoples. With the advent of this immigrant people a great advance in culture seems to have occurred, from which Rome afterward derived her supremacy in that respect: for the Etruscans were the real founders of the Eternal City.

Popularly, the word "Etruscan" at once suggests the ceramic art; the progress effected in a short time was certainly startling. To give an idea of the sudden change, we have reproduced upon

this page illustrations of typical bits of Italian pottery. The first vase, prior to the full Etruscan culture, shows its crudity at once, both in its defects of form and the plainness and simplicity

EARLY ETRUSCAN.

PURE ETRUSCAN. Middle Period.

of its ornamentation. Such a vessel might have been made in Mexico or even by our own Pueblo Indians. In a century or two some teacher made it possible to produce the sample depicted in the next cut. Perfect in form, superb in grace of outline, its decoration is most effective; yet it betrays greater skill in geometrical design than in the representation of animate life. The dog drawn on the girdle is still far from lifelike. Then come—probably after inspiration from Greek art—the possibilities in complex ornamentation represented by our third specimen. Not more pleasing in form; perhaps less truly artistic because of its ornateness, it manifests much skill in the delineation of human and animal forms. The culture culminates at this point. From profusion of ornament and overloaded decoration degeneracy begins. It is the old story of the life and decay of schools of art, time in and time out, the world over.

GREEK ETRUSCAN.

The advance in culture typified by our vases was equaled in all the details of life.* The people built strongly walled cities; they constructed roads and bridges; their architecture, true predecessor of the Roman, was unique and highly evolved. All the plain and good things of life were known to these people, and their civilization was rich in its luxury, its culture and art as

* A good recent *résumé* of Etruscan culture is given by Lefevre in Revue Mensuelle de l'École d'Anthropologie, i, pp. 112 *seq.* and 268 *seq.*, and also in Revue Linguistique.

well. In costumes, jewelry, the paraphernalia of war, in painting and statuary they were alike distinguished. Their mythology was very complex, much of the Roman being derived from it. Most of our knowledge of them is derived from the rich discoveries in their chambered tombs, scattered all over Italy from Rome to Bologna. There can be no doubt of a very high type of civilization attained as early as ten or twelve centuries before the Christian era. Roman history is merged in the obscurity of time, five or six hundred years later than this. The high antiquity of the Etruscan is therefore beyond question.

We know less of the language used by the Etruscans than of many other details of their existence—only enough to be assured that it was of an exceedingly primitive type. It was constructed upon as fundamentally different a system from the Aryan tongues as is the Basque, described in our last paper. It seems to have been, like the Basque, allied to the great family of languages which includes the Lapps, Finns, and Hungarians in modern Europe, and the aborigines of Asia and America. These unfortunate similarities led to all sorts of queer theories as to the racial origin of the people; as wild, many of them, as those invented for the Basques. It never occurred to any one to differentiate race, language, and culture one from another, distinct as each of the trio may be in our eyes to-day. If a philologist found similarity in linguistic structure to the Lapp, he immediately jumped to the conclusion that the Etruscans were Lapps, and Lapland the primitive seat of the civilization. Thus Taylor, in his early work, asserts an Asiatic origin akin to the Finns. Then Pauli and Deecke for a time independently traced them to the same Turanian source. At last, when the Etruscan civilization began to be investigated in detail, authorities fell into either one of two groups. They both agree that the culture itself was of foreign origin. The Germans, with the sole exception of Pauli* and Cuno, are unanimous in the assertion that it is an immigrant from the Danube Valley and northern Europe. These authorities regard it as an offshoot of the so-called Hallstadt civilization, which flourished at a very early period in this part of the continent. In a later paper on the Aryan culture we shall have occasion to speak of it more in detail. At the same time they declare the people racially to be of Rhætian or Alpine origin. The second school is disposed to derive the Etruscan civilization from the southeast—generally Lydia in Asia Minor. The relation of

* Von Czoernig, Helbig, Hoernes, Hochstetter (for a time), Koch, Müllenhoff, Niebuhr, Mommsen, Seemann, Steub, and Virchow. Taylor, in later work, seems to agree. Complete titles will be found in the author's Bibliography of the Ethnology of Europe above mentioned.

the Etruscan to the Greek is by them held to be very close.* Much evidence is favorable to either side. To us it seems that Deecke is more nearly correct than either. He holds it to be probable that both centers of civilization contributed to the common product. In his opinion the Etruscans were crossed of the Tyrrhenians from Asia Minor and the Raseni from the Alps. All these views, it will be noted, concern civilization mainly. It is now time for us to examine the purely physical data at our disposition. Even supposing their culture to have been an immigrant from abroad, that need not imply a foreign ethnic derivation for the people themselves.

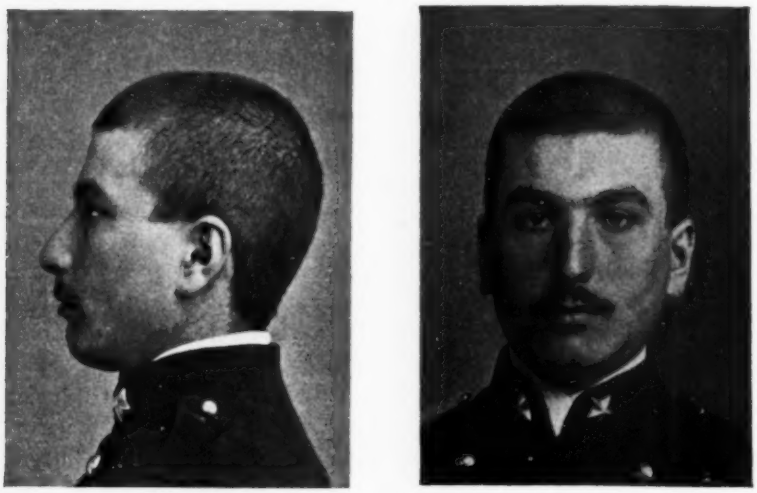
Inspection of our maps, in so far as they concern Etruria, convinces one that if the Etruscans were of entirely extra-Italian origin, their descendants have at the present time completely merged their identity in that of their neighbors; for no sudden transitions are anywhere apparent, either in respect of head form, stature, or pigmentation. On the whole, the trend of testimony appears to favor the German theory that the Etruscans made a descent upon Italy from the north; and that they were derived from the Rhætians, racial ancestors of the modern Swiss and other Alpine peoples. Thus it will be observed that Tuscany allies itself in head form to the north rather than the south. Especially is this brachycephaly noticeable about Bologna, just over the Apennines in Emilia. In this region, especially about Bologna, many of the richest archæological finds of Etruscan remains have been made. There appears to be a sort of wedge of broad-headedness penetrating the peninsula nearly as far south as Rome. This could not be if the Etruscans had been ethnically of Greek or Semitic origin; for the Greeks were and are of a type quite similar to the Italians of the extreme south—of Mediterranean racial descent, in fact. Certainly no ethnic type of this kind has contributed largely to make up the modern Tuscan people.†

To us it appears as if here, in the case of the Etruscans as of the Teutonic immigrants, we find reason to suspect that the ethnic importance of the invasion has been immensely overrated by historians and philologists. It seems quite probable that the Etruscan culture and language may have been determined by the decided impetus of a compact conquering class; and that the peasantry or lower orders of population remained quite undisturbed. It is certain that the remains of the people unearthed in their tombs betray very mixed characteristics. Crania are very rare, owing

* The Italians range themselves on this side—viz., Brizio, Nicolucci, Lombroso, Sergi, and Zampa. With them stand Brinton, Evans, Lefevre, Montelius, and Myres, with Hochstetter in his later work.

† On the Greeks *vide* Zampa's Anthropologie Illyrienne, in Revue d'Anthropologie, series 3, i, pp. 632 *seq.*, and Weisbach in Mitt. Anth. Ges. in Wien, xi, pp. 72 *seq.*

to the customs of cremation which were in vogue; such as have been studied are of all types.* It appears, from the few that have been measured, that a long-headed (Greek ?) element was rather predominant; and, as we have already observed, Lombroso and others are inclined to regard the peculiarly dolichocephalic people



MIXED TYPE. Island of Ischia. Cephalic Index, 83·6.

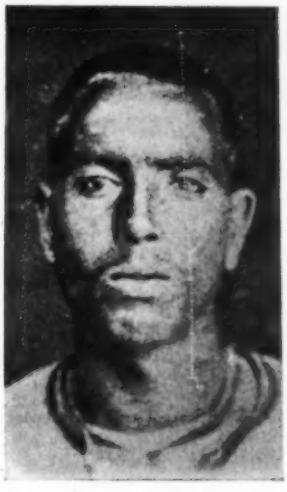
about Lucca as the last remnant of the pure Etruscan. If all Etruria were once like this, it must have changed wonderfully in the historic period, contrary to most of the experience we have related, for to-day this long-headed element is relatively quite scarce. For our own part, we regard the testimony of fifty thousand living peasants, more or less, as more credible than the evidence from a score or two of crania of uncertain origin, even though they be found in Etruscan tombs.

On the whole, we are inclined to the belief that our Etruscan ethnic origins must be sought in the north rather than in the south; in other words, that the Etruscans were an offshoot of our Alpine race of central Europe. Since the earliest times, as Zampa has proved, and it agrees with evidence from all around the Alps, there has been a steady outflow of population from this inhospitable habitat, unable as it is to afford sustenance to an increasing population. This downpour of broad-headed Alpine race types has entirely overcome the valley of the Po. In prehistoric times the people of Lombardy, Veneto, and Emilia were quite similar to the modern peasants in the extreme south. All Italy, in other words, was once Mediterranean in type. This has been proved.

* The best references on this subject (see author's bibliography) are Zampa, 1891, pp. 48–56; Nicolucci, 1869, and especially 1888, pp. 12–52.

Is it not probable that the same flood of expanding population from the north which submerged these districts may have traversed the Apennines and overflowed both Etruria and Umbria? The so-called Etruscan historic invasion may have been merely an incident in this great demographic event. This internal origin for the Etruscan *race* is rendered all the more probable by other evidence close at hand. All the chief cities were well inland. None were on the coast, where Greek or Phœnician invaders by sea would most likely have located. The Etruscans, in fact, seem to have been quite ignorant of the art of navigation; and, finally, the testimony of place names points to the Alps as a point of initial dispersion, as Canon Taylor has shown.

Middle Italy south of Umbria has little of special interest to offer. It is merely intermediate between north and south. To make this transition clear, compare the portrait on preceding page with that of our pure Alpine type on page 725 and with the pure Mediterranean type on this page. Owing to the late Abyssinian war so many of the Calabrians and Sardinians in the south were in the field that it was impossible to procure photographs of these racial types. They are quite similar, however, in head form to those which prevail in Tunis. For all practical purposes this African will do as well. Notice that the breadth of forehead and the roundness of face in our medium type stand between the extremes on either side. In pigmentation and stature the same thing is true. Little by little as we go south the Alpine blonde is eliminated until we reach the Mediterranean race in all its purity.



BERBER. Tunis.
Cephalic Index, 72.

The southern part of the Italian Peninsula is to-day the seat of a Mediterranean population of remarkably pure ethnic descent. The peasants are very long-headed, strongly brunette, and almost diminutive in stature. Especially is this true in the mountains of Calabria, where geographical isolation is at an extreme. Along the coasts we find little points of contact with invaders by sea. Apulia (see map of geography) especially contains many foreign colonies.* Some of these are of interest as coming from the extremely broad-headed country east of the Adriatic. So persistently have these

* *Vide* for details Zampa's excellent Vergleichende anthropologische Ethnographie von Apulien in Zeitschrift für Ethnologie, 1886, pp. 167–193, and 201–232.

Albanians kept by themselves that after four centuries they are still characterized by a cephalic index higher by four units than the pure long-headed Italians about them. Many Greek colonists have settled along these same coasts. They, however, being of the same ethnic Mediterranean stock as the natives, are not physically distinguishable from them.

In conclusion, let us for a moment compare the two islands of Sicily and Sardinia in respect of their populations. With the latter we may rightly class Corsica, although it belongs to France politically. Our maps corroborate the historical evidence with surprising clearness. In the first place, the fertility and general climate of Sicily are in marked contrast to the volcanic, often unpropitious geological formations of the other islands. In respect of topography as well, the differences between the two are very great. Sardinia is as rugged as the Corsican nubble north of it. In accessibility and strategic importance Sicily is alike remarkable. Commanding both straits at the waist of the Mediterranean, it has been, as Freeman in his masterly description puts it, "the meeting place of the nations." Tempting therefore and accessible, this island has been incessantly overrun by invaders from all over Europe—Sicani, Siculi, Fenicii, Greeks and Romans, followed by Albanians, Vandals, Goths, Saracens, Normans, and at last by the French and Spaniards. Is it any wonder that its people are less pure in physical type than the Sardinians or even the Calabrians on the mainland nearby? Especially is this noticeable on its southern coasts, always more open to colonization than on the northern edge. Nor is it surprising, as Freeman rightly adds, that "for the very reason that Sicily has found dwelling places for so many nations a Sicilian nation there never has been."

Sardinia and Corsica, on the other hand, are two of the most primitive and isolated spots on the European map, for they are islands a little off the main line. Feudal institutions of the middle ages still prevail to a large extent. We are told that the old wooden plow of the Romans is still in common use to-day.* This geographical isolation is peculiarly marked in the interior and all along the eastern coasts, where almost no harbors are to be found. Here in Sardinia stature descends to the very lowest level in all Europe, almost in the world. Whether a result of unfavorable environment or not, this trait is very widespread to-day. It seems to have become truly hereditary. It extends over fertile and barren tracts alike. In other details also there is the greatest uni-

* Bull. Soc. d'Anth., Paris, 1882, p. 310. On anthropology see work of Onnis, in Archivio per l'Antropologia, xxvi, 1896, pp. 27 *seq.*, besides the other authorities aforenamed.

formity all over the island—a uniformity at an extreme of human variation be it noted: for this population is entirely free from all intermixture with the Alpine race so prevalent in the north.

We have now seen how gradual is the transition from one half of Italy to the other. The surprising fact in it all is that there should be as much uniformity as our maps indicate. Despite all the overturns, the ups and downs of three thousand years of recorded history and an unknown age precedent to it, it is wonderful to observe how thoroughly all foreign ethnic elements have been melted down into the general population. The political unification of all Italy, the rapid extension of means of communication, and, above all, the growth of great city populations constantly recruited from the rural districts, will speedily blot out all remaining traces of local differences of origin. Not so with the profound contrasts between the extremes of north and south. These must ever stand as witness to differences of physical origin as wide apart as Asia is from Africa. This is a question which we defer to a subsequent article in our series, when we shall return specifically to trace the geographical origin of these great European elemental races each by itself.

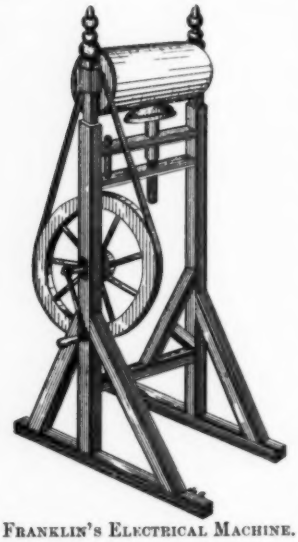
FRANKLIN'S KITE EXPERIMENT WITH MODERN APPARATUS.

By ALEXANDER McADIE.

THE recent improvements in kites have suggested perhaps to many the question, "How would Franklin perform his kite experiment to-day?" It may seem a little presumptuous to speak for that unique philosopher, and attempt to outline the modifications he would introduce were he to walk on earth again and fly kites as of yore; for, with the exception of Jefferson, perhaps his was the most far-seeing and ingenious mind of a remarkable age. But the world moves; and in making kites, as well as in devising electrometers and apparatus for measuring the electricity of the air, great advances have been made. Franklin would enjoy repeating his kite experiment to-day, using modern apparatus. What changes and lines of investigation he would suggest are beyond conjecture.

A hundred and fifty years ago a ragged colonial regiment drew up before the home of its philosopher-colonel and fired an ill-timed salute in his honor. A fragile electrical instrument was shaken from a shelf and shattered. Franklin doubtless appreciated the salute and regretted the accident. In the course of his long life he received other salutes, as when the French Academy

rose at his entrance; and he constructed and worked with other electrometers; but for us that first experience will always possess a peculiar interest. The kite and the electrometer betray the intention of the colonial scientist to explore the free air, and, reaching out from earth, study air electrification *in situ*. He made the beginning by identifying the lightning flash with the electricity developed by the frictional machine of that time. A hundred patient philosophers have carried on the work, improving methods and apparatus, until to-day we stand upon the threshold of a great electrical survey of the atmosphere. It is no idle prophecy to say that the twentieth century will witness wonderful achievements in measuring the potential of the lightning flash, in demonstrating the nature of the aurora, and in utilizing the electrical energy of the cloud. The improved kite and air-runner will be the agency through which these results will be accomplished.

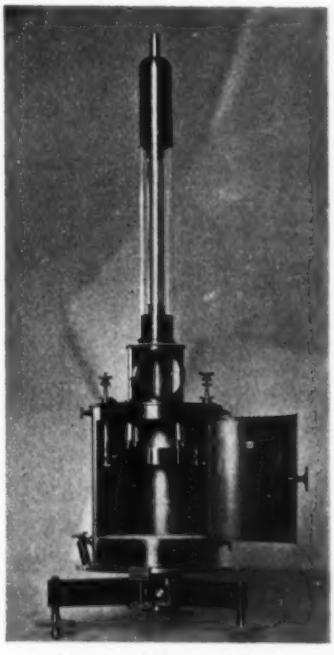


FRANKLIN'S ELECTRICAL MACHINE.

The famous kite experiment is described by Franklin in a letter dated October 19, 1752: "Make a small cross of light sticks of cedar, the arms so long as to reach to the four corners of a large, thin silk handkerchief when extended. Tie the corners of the handkerchief to the extremities of the cross, so you have the body of a kite which, being properly accommodated with a tail, loop, and string, will rise in the air like those made of paper, but being made of silk is better fitted to bear the wet and wind of a thunder gust without tearing. To the top of the upright stick of the cross is to be fixed a very sharp-pointed wire rising a foot or more above the wood. To the end of the twine next the hand is to be tied a silk ribbon, and where the silk and twine join a key may be fastened. This kite is to be raised when a thunder gust appears to be coming on, and the person who holds the string must stand within a door or window, or under some cover, so that the silk ribbon may not be wet; and care must be taken that the twine does not touch the frame of the door or window. As soon as the thunder clouds come over the kite, the pointed wire will draw the electric fire from them, and the kite, with all the twine, will be electrified, and stand out every way and be attracted by an approaching finger. And when the rain has wet the kite and twine you will find the electric fire stream out plentifully from the key on the approach of your knuckle."

Now, how would we perform this experiment to-day and with what results? Having flown big kites during thunderstorms, it may perhaps be best to describe step by step two of these experiments, and then speak of what we know can be done, but as yet has not been done.

Our first repetition of Franklin's kite experiment was at Blue Hill Observatory, some ten miles southwest of Boston, one hundred and thirty-three years after its first trial. There were two large kites silk-covered and tin-foiled on the front face. These kites were of the ordinary hexagonal shape, for in 1885 Malay and Hargrave kites were all unknown to us. Fifteen hundred feet of strong hemp fish line were wrapped loosely with uncovered copper wire of the smallest diameter suitable, and this was brought into a window on the east side of the observatory, through rubber tubing and blocks of paraffin. Pieces of thoroughly clean plate glass were also used. Materials capable of giving a high insulation were not so easily had then as now. We knew very little about mica; and quartz fibers and Mascart insulators could not be obtained in the United States. Our electrometer, however, was a great improvement upon any previous type, and far removed from the simple pith-ball device used by Franklin. Knowing that an electrified body free to move between two other electrified bodies will always move from the higher to the lower potential, Lord Kelvin devised an instrument consisting of four metallic sections, symmetrically grouped around a common center and inclosing a flat free-swinging piece of aluminum called a needle. The end of the kite wire is connected with the needle and the sections or quadrants are alternately connected and then electrified, one set with a high positive potential, say five hundred volts, and the other with a corresponding negative value, say five hundred volts lower than the ground.



MASCART ELECTROMETER.

Perhaps the most noteworthy result of these earlier experiments was the discovery (for such we think it was) that showery or thunderstorm weather was not the only condition giving marked electrical effects. The electrometer needle would be vio-

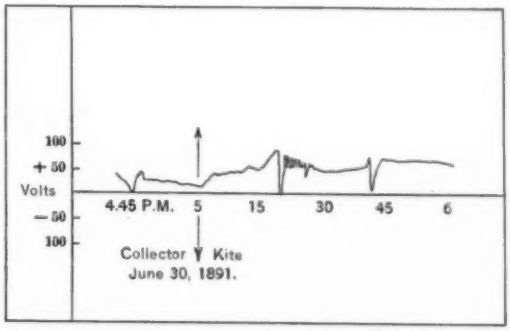
lently deflected and large sparks obtained at other times. Day after day as we flew the kite we found this high electrification of the air, and we had no trouble in getting sparks even when the sky was cloudless. One other discovery was made, and this would have delighted Franklin more than the other, for he was always most pleased when a practical application was in sight. Seated within the instrument room of the observatory, with his back to the open window through which came the kite wire carefully

MASCART ELECTROMETER, WITH PHOTOGRAPHIC REGISTER, JULY, 1892.
Blue Hill Meteorological Observatory.

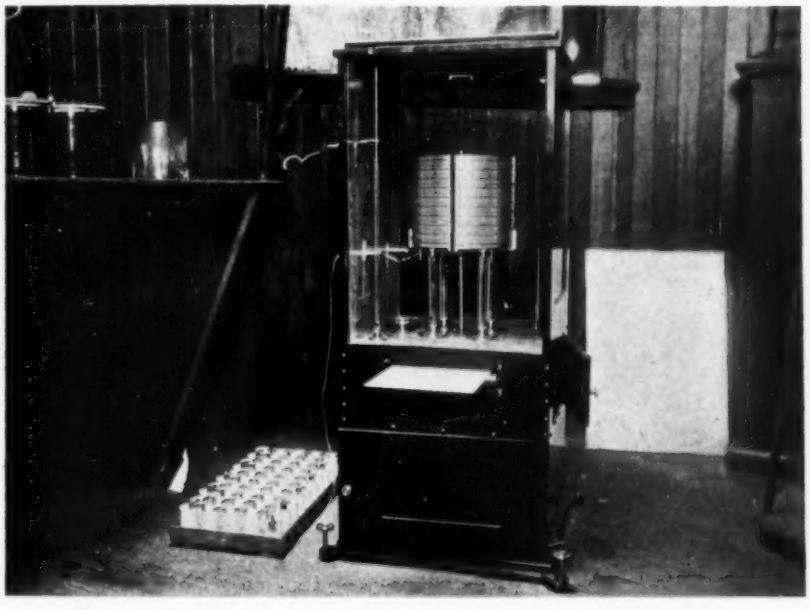
insulated, and the kite high in air, the observer closely watching the index of the electrometer could tell positively, and as quickly as one outside watching the kite, whether it rose or fell. When the kite rose, up went the voltage, and *vice versa*. In other words, the electric potential of the air increased with elevation. It must be confessed that the kites made to-day would have behaved better and flown with more steadiness than the one we used. It may have been the varying wind, or more likely wrong proportions in the kite and tail; but our old hexagonal kite

would dive even when high in air. Once we kept the kite aloft from the forenoon until late at night, but that was something unusual.

Passing now over six years in which we had been busy measuring the electrification of the air under all conditions, and discovering, for example, that a snowstorm was almost identical with a thunderstorm in its tremendous electrical changes, we come to the year 1891, when we again flew kites for the purpose of electrically exploring the air. Our experiments at the top of the Washington Monument in 1885 and 1886 (especially those during severe thunderstorms, when we obtained potentials as high as three and four thousand volts just before the lightning),



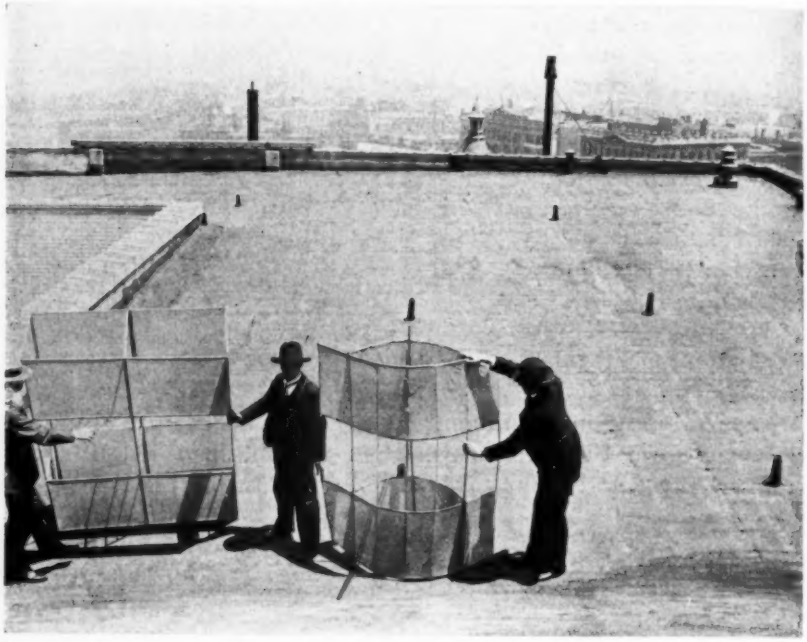
ELECTRICAL POTENTIAL OF THE AIR. Small collector about fifteen feet from ground; kite about five hundred feet from ground.



MULTIPLE QUADRANT ELECTROMETER, JULY, 1892. Blue Hill Observatory.

had given us an insight into the strains and stresses in the air, and taught us what to expect at such times. There was still little improvement in the kite, but much better electrical appa-

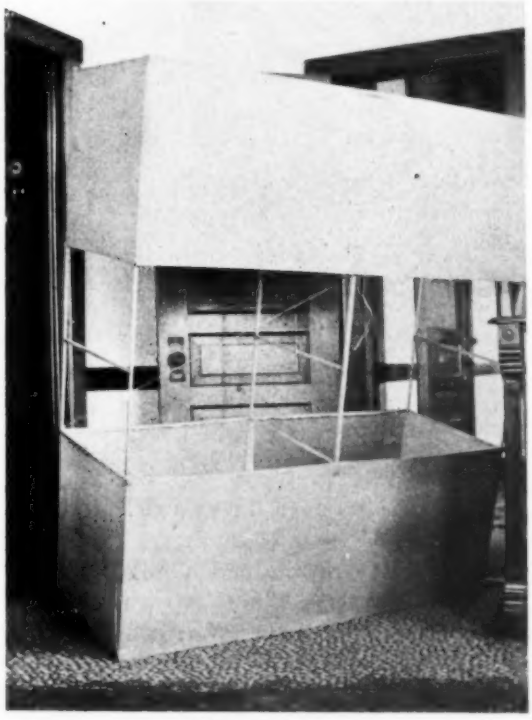
ratus was at hand. It may seem ridiculous, but we hauled nearly a wagon-load of electrical apparatus to the summit of the hill, and found occasion to use all of it. Our insulators were delicate glass vessels, curiously shaped, containing sulphuric acid, and



KITE-FLYING ON ROOF OF CITY BUILDING.

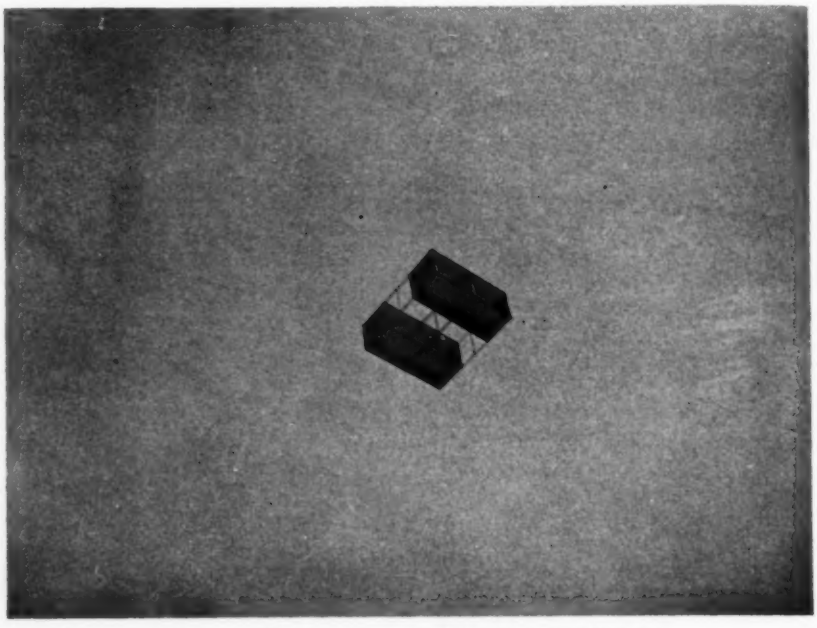
able to hold with little leakage the highest known potentials. Besides these fine Mascart insulators, we had hundreds of distilled-water batteries and two electrometers, one a Mascart quadrant, the other a large multiple quadrant. The chief aim that year was to secure by mechanical means (discarding the photographic and eye methods) a continuous record of the potential. When we can study the potential at any moment and still have a record of it, the relation of the electricity of the air to the pressure, temperature, and moisture will be more easily investigated. Among our records that year there is one date, June 30, 1891, where a direct comparison of the electrification of the air fifteen or twenty feet from the ground and at a height of about five hundred feet is shown. In one, the potential was obtained by a water-dropper collector from a second-story window in the observatory, and in the other was obtained by means of the kite. It will be seen how much higher the kite values are, although the kite was a much slower accumulator of electricity. In the next year, 1892, the kite was flown several times during thunderstorms, but generally during afternoon storms; and in the lull

preceding the wind rush the kite would fall. It was not until August 9th that we succeeded in going through a storm with the kite still flying. About 11 A. M. the kite was sent aloft, and it remained aloft until after 10 P. M. From the observatory one can see to the west fifty or more miles, and a thunderstorm came into view just about sunset. The kite was flying steadily, and whenever a finger was held near the kite wire there was a perfect fusillade of sparks. As the darkness increased, the polished metallic and glass surfaces in the large electrometer reflected the sparks, now strong enough to jump across the air gaps, and the incessant sizzling threatened to burn out the instrument. The vividness of the lightning in the west also made it plain that the storm was one of great violence, and as the observatory itself would be jeopardized, one of the four men present proposed to cut the wired string and let the kite go. But even that was easier said than done, for to touch the string was to receive a severe shock. It was necessary, however, to get out of the scrape, and one of the party took the kite string and broke the connection with the electrometer and insulators. While he was in the act of doing this, the others, who by this time were outside the building, saw a flash of lightning to the west of the hill. The observer who was undoing the kite wire did not see this flash. He saw a brilliant flare-up in the electrometer, and at the same instant felt a severe blow across both arms. Notwithstanding, he loosened the wire, and, dropping an end without, it took but a few moments to make it fast on the hillside some distance away from the observatory. There it remained for the rest of the night. A 105-volt incandescent lamp was placed between the end of the kite wire and a wire



HARGRAVE KITE.

running to the ground. There was some light, but no incandescence of the filament. It was more in the nature of a creeping of the charge over the outer glass surface of the lamp. Stinging sparks were felt whenever the kite wire was touched. The storm gradually passed over, the lightning being vivid and frequent in the west and north, and, as we learned next day, doing considerable damage. The nearest flash to the hill, however, as well as we could determine by the interval between thunder and flash,



HARGRAVE KITE IN AIR. Same kite as in preceding cut.

was forty-five hundred feet away, so that the discharge which the observer felt while loosening the wire must have been a sympathetic one. We obtained a photograph of the prime discharge, and very curiously this shows a remarkable change of direction.

This year, in some interesting experiments made on the roof of the Mills Building at San Francisco, it was noticed that the roof, which has a covering of bitumen, was a good insulator. Ordinarily one may touch the reel on which the kite wire is wound without being shocked, but if a wire be connected with the ventilating pipes running to the ground there are small sparks. Introducing a condenser in the circuit, the intensity of the spark is increased. It only remains to construct an appropriate coil of the kite wire and place within it another independent coil. In the outer coil a quick circuit breaker may be placed, and theoretically at least we shall transform down the

high potential and low amperage charge of the air to a current of less potential and greater amperage. This can be put to work and the long-delayed realization of Franklin's plan of harnessing the electricity of the air be consummated. It may not be a profitable investment from the commercial standpoint, but no one can say what this tapping of the aërial reservoir may lead to. Determining the nature and origin of the aurora will be as great a scientific achievement as utilizing the energy of Niagara Falls.

THE PSYCHOLOGY OF BELIEF.

By W. B. PARKER.

IN considering the psychology of belief we find ourselves face to face at the very outset with the questions: (1) What is the nature of belief? (2) What are the conditions under which it arises? and (3) What are the causes for its appearance? In trying to answer these questions we have to say frankly, before crossing the threshold of the topic: We have no key to secret chambers; we propose no revelations, but only another look over what may be very familiar premises.

To the question, What is the nature of belief? many answers have been given. Hume declared, "Belief is nothing but a more vivid, lively, forcible, firm, steady conception of an object than the imagination alone is ever able to attain." Prof. Bain said, "Belief in its essential character is a phase of our active nature." The answer we shall give to the question shall not necessarily conflict with either of the answers given above. It is best given by defining our point of view.

We look at man as a physical organism of rare sensitiveness, played upon by the forces of the world. Light and sound, the blowing wind and the solid ground, all make their varying sorts of contact with the delicate, susceptible organism. But not all of the myriad voices are heeded, not all the thousandfold seductions entice, not all the sweet odors or the pleasant touches of the great world call forth response. In fact, this human organism is not unlike that lowlier organism, the sponge, through whose length and breadth streams from the great ocean flow. There is no current in the Atlantic, no distant sea, however narrow, but may send its contribution of richly laden sea water to the sponge's mouth. But not all the nitrogen, carbon, iron, that the tide bears is taken up by the sponge. It extracts only what it needs, what it can assimilate, and to most that passes remains, perhaps, insensible. So with our more complex organism—man. He, too, is set in the midst of oceans of sensation. Sounds, sights, odors,

tastes, and touches flow round him in limitless variety. Of many, perhaps of most, he is never conscious; to only a few does he respond.

Objection may be made to the analogy, but on examination I am sure it will be found to be sufficiently close for our own purpose. To the mind, sounds, tastes, colors, odors, and sights are what foods are to the sponge—they are stimuli. Specialists on the eye tell us that the range of light vibrations to which the human eye responds is but a little break in a great series, like a short stretch cut out of the middle of an inclined plane. So, too, with our ears. They can intercept only a few of the possible sound vibrations that make up the world of noises. As the sponge, then, comes in contact with but the merest vialful of the great ocean, the human organism also makes contact with mere fragments of the world's infinity of stimuli.

There is a second respect in which the analogy holds good. Just as, out of the limited flow of food-laden sea water that passes its doors, the sponge chooses what it needs, what it can assimilate, so the human organism, out of the limited variety of stimuli to which it is competent to reach, chooses such to respond to as are important.

Now, what has this to do with belief? Simply this, that belief, whatever else it may be, is a human function, and in so far as it is vital and important it must be subject to the fundamental laws of the organism. We can neither believe nor disbelieve what we never come in contact with, and the stress of life causes us to believe only what is important to us, as the sponge absorbs only what will nourish it. I do not say we are incapable of believing a thing that is useless for us. It is possible for an organism to take and to treat as food that which is valueless. But in the main, life means taking what is good, and taking what is not good means death. This is as true of the mental life as it is of the physical life, and for the most part the process of choice is instinctive and unconscious. When the thermometer falls we have sensations of discomfort—we may respond by taking off our clothing. It is conceivable that we should believe it is getting hot. But we do actually respond by putting on our overcoats, which is good evidence that we believe it is cold.

This, I take it, is what Prof. Bain meant when he said, "In its essential character belief is a phase of our active nature," and I do not think it conflicts in any way with Hume's account of belief as a "more vivid, lively, forcible, firm, steady conception than the imagination is able to attain." In fact, both of these accounts seem to me very true. What I mean by believing my friend's word is not that I have a clear perception that his words represent definite things, but that I conceive the main thing he de-

scribes or the opinion he declares in a thoroughly lively way—in fact, so warmly do I embrace it that I am willing to act upon it.

The nature of belief is to be a part of our active nature; it is related to the will. We believe a thing when we accept it and are willing to act upon it.

We set for our second question, What are the conditions under which belief arises? These are of two kinds. There are mental conditions and physiological conditions.

The physiological conditions of belief will of course be primarily those, if there be such, which are indispensable to all mental activity. Now, since of physiological activities in general there is an unfailing register in the circulation of the blood—i. e., innervation of muscle or nerve at any point is accompanied by an increased flow of blood to that point—we may take the flow of blood as one means of registering physiological activity. With this as a test we can affirm that there are physiological conditions for all mental activity. In fact, the investigations of Mosso, the Italian physiologist, enable us to measure the increased flow of blood to the brain which accompanies simple mental operations. A delicately balanced bed scale on which the subject is placed reveals the fact that the simplest mental operations, as answering a question or working out a problem in mental arithmetic, is registered in increased weight of the head—i. e., greater blood supply. Increased rapidity of circulation is then a prime physiological condition of belief. This gives a key to the conditions under which belief arises. In general they may be summed up under one head—heightened vascular and nervous activity.

If we stop and ask ourselves how did we come to believe such and such a thing, we shall find in almost every case that it was under excitement. Did ever a girl sit down calmly and reason to the conclusion that she was in love? Did ever a man or woman reason to the conclusion that he or she was saved? No, belief does not come that way. Every orator learns that. It is not the close-woven, incontestable argument that leads to belief. It may be a good preparation, but often the result can be gained wholly without it, and I doubt if it is ever indispensable. Men and women are moved to believe, not by argument but by aroused feeling. Just as when anger is aroused some outlet must be had, so when the active nature is aroused something must be believed. The person who at a revival meeting happens to be unmoved, finds it hard even to conceive the intensity of conviction which possesses the kneelers at the mourners' bench.

Anything, then, that arouses the physical activities may be expected to stimulate belief. This will be found to be true. Excitement of any sort seems to quicken conviction. Stimulants arouse belief. I hope some one will make a thorough study of

this matter. I am convinced it would repay the labor. The different effects produced by different sorts of stimulants would make a valuable contribution to this subject: for instance, coffee seems to awaken almost as many doubts as it lays, while alcoholic stimulants seem invariably to dispel doubt and enthrone certitude.

Some men depend upon their pipe to give them the needed start to the conclusion of problems. I confess that I seldom feel so sure of the solidity and reality of the world as when I have my favorite amber stem firm set between my teeth. And much of the tenacity of religious conviction of our Methodist and Baptist brethren is due to conceiving the articles of their creed with passion bred in the excitement of camp meetings.

Perhaps more marked than any of these is the effect of sexual feeling. It is practically impossible for either of two people to believe in the love of the other without feeling some warmth of feeling himself. It is the feeling that awakens doubt or conviction.

This leads naturally to the interrelation of feelings and beliefs. The close relation of love and religion has been a topic for ages. It is, I think, remarkable how many women disappointed in love turn to religion for consolation. Girls and women who have never revealed the slightest interest in church or creed become, under the influence of an unrequited passion, the most ardent believers. There is no reason in such cases to charge hypocrisy. They only show how much belief depends upon emotion. It is as if the feelings, deeply stirred, must react strongly. So long as the nature is left passive, belief, whether about love, politics, or religion, seems needless; but once the feelings are aroused, a hunger appears that demands satisfaction in some conviction or other.

The physiological conditions of belief, then, are, in a word, stimulation—excitement. There are also, as we agreed, mental conditions of belief. These are, as follows from the volitional nature of the function, such as conduce to a heightened state of all the mental activities, but especially the imagination and the affections.

Repetition or pondering over a matter helps us to believe it. We accept many a thing by its familiarity. Many of our creeds are believed in this way. The mental condition of acquiescence is brought about by frequent repetition, just as memory is made firm by the same means. Pondering over things, themselves imaginary, makes them real to us. Prophets come to believe in themselves and their mission, not so much by reasoning about it, but by steadfastly fixing the goal of their desire in the mind until, out of a fancy, it grows to a clear conception, and from a conception becomes, for them at least, a reality. So with us all;

we gain rest in belief often by putting reason out of doors. Maudsley says: "To say that the great majority of men reason in the true sense of the word, is the greatest nonsense in the world; they get their beliefs as they do their instincts and their habits, as a part of their inherited constitution, of their education, and the routine of their lives."

That this is true is shown by popular superstitions. Almost every hamlet in Europe has its own ghost story, believed ardently by the local inhabitants, and scoffed at by those of the next village.

We have insisted that, because belief is a function of the active nature, whatever conduces to greater physical or mental activity will conduce to believing. We are prepared to believe, then, that in joy we believe more than in grief. A low state of mind—sorrow, remorse, melancholy—is a field where doubts grow rank, but the cheerful, successful, hopeful mind finds belief easy. It is failure that makes us cautious; success emboldens us and like rumor, multiplies as it goes, loosing our fancy and making credible what was but just now impossible.

Again, inaction kills belief, while action of any sort nourishes it. Phillips Brooks was fond of saying, "Do something with your religion, and your religion will not die." So with all our beliefs. Though it is often bred in our mind by pondering things over, calling up images until they become fixtures, belief is oftener born and nourished in earnest action. Lincoln's life gives a notable example. In his pioneer days he was a skeptic. Both Lamon and Henderson say that up to the time Lincoln went to Washington as President he was not a professing believer in any Christian faith. But during the days of the war, when Lincoln bore tremendous burdens of action and anxiety, embodying and enforcing the will of the nation, he became thoroughly religious. It is told that in 1864, when the tension was at its highest, and Lincoln's life was like the action of the heart of the whole people, in that time the President was found more than once on his knees at prayer. Lincoln's faith did not come to him by reasoning, but in the stress and strain of life. He laid hold upon certain great truths with the grip of a hungering and thirsting nature. It is in this way, I believe, that the strongest faith is attained. With his whole nature stretched to its highest tension, no man can avoid conviction. So long as he merely rests, remains inactive, passive, he may get along without a faith; but when his soul is awakened and his feeling is aroused, believe he must.

We have seen that in both sets of conditions for belief, physiological and psychical, the same thing holds; because belief is a function of our active nature, whatever stimulates and rouses to action promotes belief.

We may now turn to the third question we set ourselves: What makes us believe? In general and roughly, the answer to this question is—the vital impulse. We believe because we want to, because we have a constitutional trend toward belief. This follows from the fact that belief is a form of action, and we are driven by a passion to act. I have said this is constitutional; it is the very inwards of our vitals; there is nothing that so sums up the meaning and essence of life as the passion to do. A living organism is more than a tense spring; it is a spring growing constantly tenser and fretting to unleash its own forces. This vital tension makes all consciousness motor, and makes every idea a discharging force with inevitable consequences in overt act or intraorganic disturbance. To apply a suggestion to an active mind is like applying anything to a baby's mouth. Both alike show an instinctive tendency to close on whatever offers, be it sealing-wax or sweetmeat. We see this plainly in the workings of a savage mind. For a savage to conceive anything vividly is to believe it. Some such indiscriminate appetency of belief offers the only sufficient explanation for the vast higgledy-piggledy mass of superstition that belongs to primitive peoples.

This is, I take it, what Bain meant when he said that the chief fact of belief was primitive credulity. We are all naturally and primarily credulous; skepticism is a later development and comes from the sort of experience that makes sadder but wiser men of us. It is in life itself, in its appetency, its passion to act, that we find the prime cause of belief, which is, in fact, merely a gratification of this vital desire. As the sponge needs no other justification for absorbing nitrogen from the sea water than its own nutritive instinct, we need no other excuse for believing than the instinct of activity.

Yet this is but one side of the matter, and plainly enough the rougher, more general side of it. I eat because I want to, is but an imperfect answer to the question why I eat, and even the addition that I eat because the vital processes demand satisfaction that can be provided only by food, still leaves the matter much beclouded. In putting down belief as the gratification of a vital desire, we have only found the big, crass motive for believing. To answer fully the question, why we believe, demands that we go further. We must be prepared to find here, too, that the ground is an organic, constitutional one. The first reason for believing at all is because we are alive, not dead, and crave action, not torpor. The reason why we believe *as we do*, and the sort of things we do believe, is because we have the sort of constitution we have. We have seen already that, of the myriad sights the sun makes, only a slight proportion affect our retina; we have learned that of all the thousandfold possible excitants

of nerve and muscle, comparatively few ever produce in us sensation. This is matter of mere physical organization. We are conscious of a much more important selective process. We know that we do choose what things we shall respond to, and what not. We are now brought to see the two chief phases of belief, the voluntary and the involuntary sides of it.

Much has been said of the uncontrollable nature of belief. This is no mere fancy. We do believe in an involuntary sort of way, much as a child puts everything into its mouth. In fact, Prof. James has said, "Whatever is uncontradicted is *ipso facto* believed." In such a sense as this, belief is uncontrollable. But the other side of the matter is more important. We may will to believe—that is, we may choose what we will believe and what we will not believe.

This possibility of choice depends upon two things, one subjective, the other objective. To the former fact Prof. James has already called attention in pointing out that the same things may seem different to us.* My table-top, for instance, will look like a rhombus, a square, or an oblong rectangle, depending upon the point of view. I deliberately choose to regard it as a square, and in so doing ignore the other aspects, which none the less remain equally true and real. The second fact upon which the possibility of choice depends is a matter of mental constitution. Prof. Royce gives this a very clear statement. "We are prejudiced," he says, "in favor of regularity in the world; and so we continually manipulate the data of sense for the sake of building up a notion of a regular, necessary, and simple universe." Just as the sponge, again, by its constitution of calcareous outer skeleton and soft inner substance, must prefer to absorb from the varied materials offered by the passing current lime and carbon, so we choose what we choose largely per force of our racial and individual constitutions.

"And so," continues Prof. Royce, "though it is true that our knowledge of the world is determined by what is given to our senses, it is equally true that our idea of the world is determined quite as much by our own active combination, completion, anticipation of sense experience."† It is unnecessary to repeat the arguments upon which the conclusion Prof. Royce reaches is based. I have already indicated them. Because we can receive more sensations than we can follow, we choose to reject some and retain others, thus carrying out consciously the selective process that our organization unconsciously begins. Now, what Prof. Royce emphasizes is the fact that this conscious process of selec-

* Prof. James, Principles of Psychology, vol. i, p. 285.

† Religious Aspect of Philosophy, p. 322.

tion, which is inevitable, follows certain lines, namely, of simplicity, necessity, regularity. As he puts it, we are prejudiced in favor of certain aspects of the world, and impose them upon the phenomena with which we come in contact.

This brings us again to the active side of belief. To quote Prof. Royce again: "Every one is certain to be prejudiced, simply because he does not merely receive experience, but himself acts, himself makes experience." That is, everybody makes his own belief, his own knowledge to some degree. And if we will only watch closely our own mental movements during the process of coming to a decision, we shall see how true this is. During such a process there is a period of balancing one side against the other, of more or less keen scrutiny of reasons, of swift discussion back and forth, accompanied by a tension and excitement rising to the height of exaltation. There is perhaps no attitude in which the mind shows greater activity than this of questioning. We have many times felt the drop that comes with decision. The swift and agile leaping back and forth, the piercing looks cast on this side and on that, are all stopped, sometimes for very weariness, but almost always with a slight sense of depression, like settling after flight. The act of deciding, of accepting one of two alternatives, does really seem, at the moment of doing it, like a lower form of action. It is not intellectual, but volitional. I am quite sure no man ever chose a sweetheart without a little sense of coming down from the freedom and daring of uncertainty. It is like the feeling we may imagine a cloud to have on condensing into rain. It has become effective at the cost of freedom and elasticity. This condensing, dampening turn of conception is belief, and it is our will, our activity, the momentum of our life that bring it to pass.

Though belief is thus primarily an expression of the instinctive force of life, determined by intelligence and choice, what we may believe is a matter of circumstance. To believe what one has never heard of is manifestly impossible. Further, inasmuch as belief means laying hold on a conception, accepting it as a basis of action, it is necessary not only to have the matter come before one's mind, but also to attend to it—to see it clearly. Hume was right in insisting on the liveliness, clearness, permanence, and firmness of the conception that is believed. We do not as a rule believe our dreams, but let a dream recur again and again, and few of us will be able to refuse it credence. Many things come to be believed by their traditional weight of authority. The creeds of Christendom have come down to us with the force of centuries behind them. They are accepted in their traditional form chiefly because by multitudinous repetitions they have been

beaten in upon the mind, and in most cases have been yielded credence without question or reasoning.

Finally, at the peril of tediousness, let me repeat, belief is a vital function. Whatever arouses and stimulates the active nature, looked at from the physiological or psychical point of view, helps to awaken and further belief. The forces that we call life make for belief. We all want to believe. Primitive credulity is an experience for us all, and it is just this vital side of it that accounts for our tendency to accept rather than to reject. So long as belief remains an active function, and so long as life remains a bundle of functions united to delight in their activity, we shall have a healthy desire to believe rather than to doubt.

FREE-HAND DRAWING IN EDUCATION.

By H. G. FITZ.

MR. CHARLES WHEELOCK, Head Inspector of the Regents of New York State, voicing the opinion of fifty-five hundred teachers in this State, says, that for the twenty years during which drawing has been a part of the curriculum of the public schools, "*the results are not much of anything.*" *

This statement, coming from such a source, is worthy the careful attention not only of teachers, but of all taxpayers as well. If true, it seems that for each child in the public schools of this State about forty hours a year are wasted; this means an aggregate of years of time and thousands of dollars.

The Art Students' League of New York city gathers pupils from most of the States in the Union. It stands second to no art school in America. Mr. Henry Prellwitz, a well-known artist of this city, and instructor of the portrait class at the Pratt Institute, Brooklyn, N. Y., has for some time past been Director of the League, and has had ample opportunity for studying the work of those admitted to the classes. His opinion is that "applicants who have been trained in other than pure art schools have *received no benefit from their lessons in drawing;* their efforts have been misguided, the undoing of which results in loss of time, and their progress is less rapid than those who have received no such previous training." Mr. Edward A. Bell, a well-known figure painter, who was awarded the bronze medal at the Paris International, also second Hallgarten prize at the New York Academy of Design, who has had several years' expe-

* School Journal, June 10, 1896, p. 728.

rience as a teacher, agrees entirely with the opinion expressed by Mr. Prellwitz. Mr. Dwight W. Tryon,* N. A., Professor of Fine Arts, Smith College, whose reputation as an artist is international, whose pictures have been practically loaded with medals, the list of which would be too long to publish here, has had vast experience as a teacher, but has taken no note of the previous training of the pupils that come under his observation. He says of the average adult, "The power of observation seems *hopelessly atrophied.*"

The above-quoted opinions of men who have a reputation as artists in the highest art circles seem to corroborate Mr. Wheelock, and extend the application to the whole country, the opinion of the "art teachers' associations" to the contrary notwithstanding.

The late Mr. William M. Hunt, reputed one of the ablest art teachers of America, said to his pupils: † "You don't drill enough. None of you know what mechanical drawing is. Go into the schools where that and nothing else is taught, and try to add their exactness to what you are now doing. . . . One thing let me tell you: you must learn to make exact lines." ‡ This opinion, held almost universally, that the mechanical drill of drawing exact measured lines and spaces leads to the exact observing of lines and spaces, form and color, has led to the use of *mechanical drawing methods* to obtain accuracy of location in educational free-hand drawing. It seems plausible; but mechanical drawing, like writing, is to a degree technical. "What arts and skills a young man may learn of any master for the sake of mere advantage is in itself just as indifferent to the educator as the color he chooses for his clothes." *

By actual measure the error that will escape the effort of the mechanical draughtsman, directed for fifteen minutes to its removal unaided by any mechanism, will be four times as great as the error that will elude the figure painter for a like time, opinions of the figure painter to the contrary notwithstanding.

The following table shows the error, in inches and fractions, and angle in degrees, that will be left by the average adult recorded in the several vocations named:

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* Tryon, Dwight William, born in Hartford, Conn., 1849. Pupil of Daubigny, Jacquesson de la Chevreuse and Guillement. A. N. A. Member of American Water Color Society. Medals, American Art Association, 1886 and 1887. Second Hallgarten Prize, 1887. Ellsworth Prize, Chicago, 1889. Palmer Prize, Chicago, 1880. Webb Prize, 1889, and many more. (Catalogue Society of American Artists, 1891.)

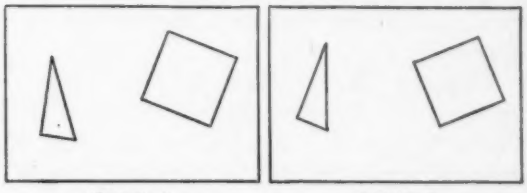
† W. M. Hunt. Lectures, second series, p. 17. Houghton, Mifflin & Co., 1883.

‡ Ibid., p. 36.

* Herbart. Introduction to General Pedagogics.

A.*	Figure painters of national repute	·08	2°
B.	Landscape painters, *telegraph operators*, coasting and yacht mates and masters, village blacksmiths, expert baseball players	·17	4°
C.	Mechanical engineers	·30	7°
D.	Mechanical draughtsmen	·40	9·5°
E.	Teachers, journeymen house carpenters, farmers thirty years old or more	·50	12°
O.	Children eight years of age	2.00	50°

To remove opinion the test must be equally new to all tested. It must be easy enough for the child of eight to draw quickly; difficult enough, so that the most expert of any age will be unable to reproduce it perfectly. To be novel to all it must be abstract. The above table is the result of measures obtained in the following way:



Test No. 1
ASSISTED ATTENTION

Test No. 2
VOLUNTARY ATTENTION.

Tests No. 1 and No. 2, mechanically enlarged to three feet by two feet, are placed vertically before groups of from twenty to fifty or more individuals. The copies are drawn on paper nine by six inches, and must not be raised from the horizontal position.

The usual mechanical aids to accuracy, such as measuring by the hand or pencil held between the eye and the object, are not allowed in any way.

For test No. 1 the operator calls attention to the chart that is to be proportionally reproduced by words that in no way hint at the position or proportion, and by motion, pointing out and holding for a few seconds, until recorded, each point on the chart. The time consumed will be about two minutes, and the result tabulated for age and error may be read in line No. 1 on large chart, *showing no variation for age.* The least error is nothing; greatest, six tenths of an inch; average, three tenths of an inch. Between this line and the top of the chart lies all the error of eye and hand. *The eye of the child sees as accurately as the adult's.*

Test No. 2 is to be drawn under exactly the same conditions as the above, except that *no word or motion must aid the attention* of those drawing, either to the chart or their copy of it. The attention given it must be *voluntary.* The result, measured and charted by age, position, and angle error, may be read for any age—eight to twenty—on line No. 2. This curve is the center of

* These letters will be found on chart, indicating the relative position of the centers of these groups.

groups selected and associated by the school examinations into classes. The adult end of it (seventy-five per cent) is the position of the center of groups trained in the schools of the United States and part of Europe. The adult farmer who does nothing else stands on exactly the same center as those graduated from the high schools and colleges who have been licensed to teach. The *youth* of the rural districts *stand five per cent higher than the adult,* but they will not all be farmers; many of them will drift into the cities and become successful business men with a center at eighty-five per cent or more, which is the point of accuracy attained by *all* those of *any profession reputed by co-workers* to have marked ability, which means, as read from the chart, the successful have as much power to direct their own attention to the uninteresting thing as can be lent to them by external aid. That the *average school training has carried* those who have followed it *no nearer success in drawing than those who have not been so trained* seems to go far toward taking Mr. Wheelock's statement out of the realm of doubt and extending the scope of it to the school drawing of Europe as well as to the "great State of New York."

Not the least singular of the facts brought out by these experiments is that, while the figure painter (position A) needs ninety-five per cent of the power measured by the test, and the landscape painter (position B) has acquired ninety-two per cent by years of labor, the telegraph operator (also position B), whose training certainly has not been toward *eye accuracy,* should also be able to locate by observed proportion and direction to ninety-two per cent. By what means did he get the power to locate with an accuracy almost double that possessed by the average mechanical engineer? The telegraph operator has been trained in *voluntary attention* to such an extent as to be able to listen to certain sounds, *not in themselves interesting,* and *inhibit* all others. Herbert Spencer says success in everything depends on the power of observation.

It seems that the foundation of the power of observation is *voluntary attention.*

Balzac is quoted as saying, "Almost the whole of human genius consists in observing well." And Taine writes, "Success in life depends on knowing how to be patient, how to endure drudgery, how to make and remake, how to recommence and continue without allowing the tide of anger or the flight of the imagination to arrest or divert the daily effort." *

Prof. William James writes: "The faculty of bringing back a wandering attention over and over again is the very root of

* Art in the Netherlands, p. 23.

judgment, character, and will. . . . An education which will improve the faculty will be *the* education *par excellence.*" *

Whether any one, in the ordinary lay interpretation of the act, is ever able to draw or not is of very little educational importance. But, since we see that the ability of the telegraph operator to attend by ear gives him also the power to attend by eye, we may infer that training to *conscious and effective* effort by one sense trains all others to some extent. The inference seems rational that training one to *attend* by eye will strengthen the power of observation in all directions.

The above-quoted opinions all seem to point to the ability to set aside the things that clamor for attention and attend to those that ordinarily escape our observation, as the foundation of success.

Line No. 2 (on chart) differs from line No. 1, because the subject must, before an attempt to locate is possible, determine which of the points will be taken first. This having been selected from the seven and located, six remain. The choice must be made six times, the location seven, each of which is the result of a distinct conscious effort of the will in "bringing back a wandering attention," which, if left free, would be like Huldy's feelin's described by Lowell:

> All ways to once her feelin's flew
> Like sparks in burnt-up paper."

To arrest those sparks, bring them back, and hold them for a fraction of a second, means a considerable conscious mental effort, each of which brings nearer the state where fatigue prevents further effort and the sparks are followed instead of driven; hence the curve.

The very young child has a good conception of the vertical and horizontal positions and of their conventional representatives in lines. But when the line is oblique, the *concept* of it, as oblique, is altogether insufficient for representation. It slants right or left. This or that end is high, how much? †

The composite drawing of fifty-three pupils, average age

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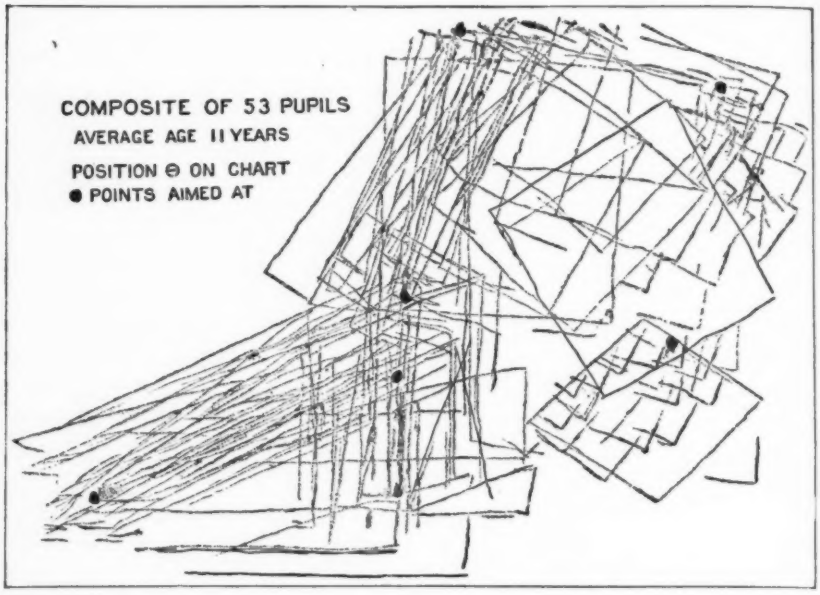
* Psychology, William James, p. 228.

† In the tests for line 2 no lines were horizontal, none vertical, none parallel to each other or the margin of the paper, no line prolonged would hit an angle. On the nine-by-six-inch paper the triangle sides were 3·4 inches, 3·05 inches, 1·55 inches. The longer diagonal of the trapezium measured 4·1 inches; the sides, 3 inches, 2·87 inches, 2·90 inches, and 2·86 inches. The measurements for the chart were obtained by placing a test sheet over the drawn one, matching the edges with care, and making with a point holes for the true positions of corners, as mechanically located on test sheet. The errors were aggregated on a slip of paper and divided by the number of points (7). The greatest angle error was then selected and divided by 24 (because that figure seemed to make the angle error coeffective with the distance error). The result is added to the average of the first,

eleven (position on chart at ⊖, a year and a half above the average of their age), shows the vertical recorded nearly upright fifty-one times, greatest variation twenty degrees, while the ob-



lique lines of the trapezium show the maximum possible variation forty-five degrees, with few lines near the right slant.

The so-called child drawing, so much written about of late, that Herbert Spencer and many others deem of educational importance, may be described as line making without conscious effort—the graphic record of a muscular movement associated with a concept. It becomes more plausible as years advance, but never gets beyond caricature, and has no direct educational value.

Drawing, to have educational value, must be the graphic record of a perceived fact.

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divided by 2. To get per cent, divide by 2 again and subtract from 100, because $\frac{2}{100}$ inch = 1 per cent. Thus, total error, 2·1 inches; greatest angle error, 7·2°.

$$2{\cdot}1 \div 7 = {\cdot}3; \qquad 7{\cdot}2^\circ \div 24 = 3;$$

$$\begin{array}{r} {\cdot}3 \\ {\cdot}3 \\ \hline {\cdot}6 \div 2 = {\cdot}3 \div 2 = {\cdot}15; \end{array} \qquad \begin{array}{r} 100 \\ {\cdot}15 \\ \hline 85 \text{ per cent.} \end{array}$$

When time is limited and an approximation is desired, the greatest angle error treated as above will give a result within two per cent of an average for a class.

The angle error may be ignored where the personal position is not desired, as it will change the average center but little, the personal position very much, particularly of the concept recorders.

The drawing in itself is of no consequence except as it stands for the record of an *exploration* and *discovery*. The teacher, to succeed, must be able at a glance to determine whether the child is recording concept or percept.

The result of training the child to *explore, discover,* and *record* is shown by the dotted line beginning at the eleventh year on line 2 of large chart, ending at fourteenth year (No. 30). This line is the history of a parochial school. The pupils had thirty minutes' exercise a week for about thirty weeks a year up to the first circle, from then on one hour a week for about thirty-five weeks a year. The average rate of increase in power of observation equals maintaining the average rate from the ninth to the tenth year, to the fourteenth; twenty per cent above the average of their age, ten per cent above the adult average. The line beginning in a circle at the sixteenth year, ending at nineteenth year at No. 19, is the history of a high-school class under the same drawing teacher as the above described. They received four times the training (one hundred and eighty hours a year) given the parochial school, and made, as the chart shows, exactly the same increase in two years that the former compassed in eighteen months. All the lines between these two are of classes trained by the same drawing teacher and the same method; the numbers in which they terminate indicate the number of pupils of which the circle is the center.

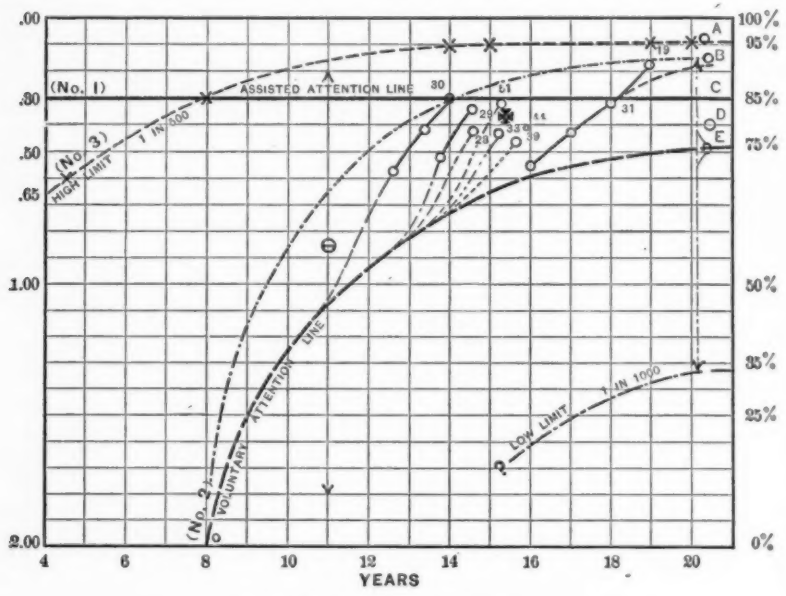
Is it not possible that between the lines 30 and 19 we may read the record of the atrophy suffered because of too much instructing, by putting the child in possession of facts instead of faculties, described by Dr. H. E. Armstrong, F. R. S., and in the article* in which he also writes: "In the future *all subjects* must be taught *scientifically* at school, in order to inculcate those habits of mind which are termed scientific habits; the teaching of *scientific methods*—not the mere shibboleths of some branch of natural science"?

We see by the chart that the class that began to study drawing as a science at eleven, at twelve and a half had reached seventy-seven per cent, three and a half years in advance of the later class; they reached eighty-five per cent four years in advance of the (31) boys of the high-school class, and that at an *expenditure of one fourth the time.*

The value of this training is necessarily a matter of opinion. The regular teachers of the classes shown on the chart at positions 29, 28, 33, 51, 39, 44, estimate that the one hour per week exercise in drawing as a science study, by the reduction of time required for a certain subject, makes the class of fourteen years

* Popular Science Monthly, September, 1894.

equal one of fifteen years not so trained. Four of the teachers place the gain at from forty to fifty per cent in study power. One teacher (class position 44) puts the gain at one hundred per



EXPLANATION OF MARKS ON VOLUNTARY ATTENTION CHART.
21,600 measurements of 2,700 individuals.

The error to two inches may be read in tenths of an inch at right-hand end of horizontal line, at the left end read up the lines are five per cent apart; 0 per cent arbitrarily placed at eighth year; vertical lines divide year spaces fourth to twenty-first.

Line No. 1 (at thirty inches and eighty-five per cent).—Externally sustained attention. All those reputed by coworkers to be superior are at or above this line by test No. 2.

Line No. 2.—Voluntary attention. Average line of centers of groups trained in the schools of many States in the Union as well as Europe.

Line No. 3 is the high limit of the above and ends in A. × marks the individuals through which the line is drawn. From fourth year to fourteenth all are females. From fifteenth year up all are males. ? Marks the rather doubtful lower limit of groups.

⊖ Marks center of composite drawing, average age eleven. ^ v High and low limit marks.

◙ Marks the center of three hundred and seventy pupils trained by free-hand drawing as a science study.

O Marks known positions.

▬▬ Movement between measured centers.

—— Supposed movement.

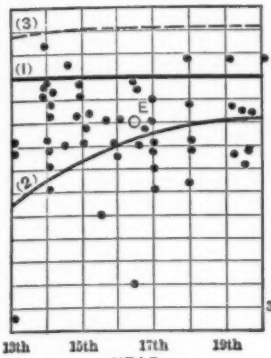
○A Figure painters measured in the order named: E. A. Bell, Clark Crum, C. C. Curran, Kenyon Cox, Joseph Boston, Arthur B. Davies, Henry Prellwitz.

○E Fifty-three teachers. ^ v High and low limit marks.

cent in geometry, claiming to have covered certain ground satisfactorily in half the time usually needed for a class without the special training.

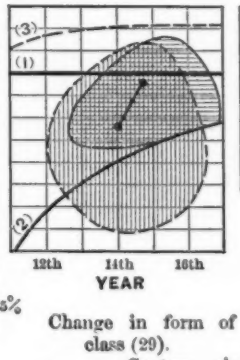
By imagining line No. 3 (the high limit of group) prolonged downward and to the left, three years, and line No. 2 treated in the same way to the same age (one year), it will be seen that at the age of twelve months children are almost infinitely separated

in power of observation. At eight the average has reached, through the training of life's experiences, to within hailing distance of the leaders eighty-five per cent away; at fourteen the average will be seen to have gained on the leaders so much that only thirty-two per cent divides them. At twenty only twenty-five per cent stands between the average and the highest human

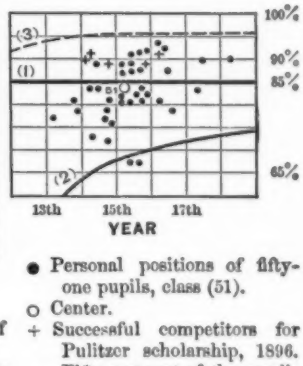


GROUP E.

● Personal positions of fifty-three teachers. Ages placed at thirteen to twenty for comparison.
○ Average center.



Change in form of class (29).
●——● Centers six months apart.



● Personal positions of fifty-one pupils, class (51).
○ Center.
+ Successful competitors for Pulitzer scholarship, 1896. Fifty per cent of the candidates came from this class.

attainment. By a more complete coordination of scientific and educational methods, I believe there will be no trouble in raising the average, now at line 2, to the dotted line above it, beginning at eighth year, passing through (Fig. 30) at fourteenth year, ending at (B) twentieth year.

This would make the power of the average child at twelve years, by the above-described test, equal to that now acquired by the average adult, and the gain would not be attained by giving power to a few already bright pupils who do not need it, but by bringing all those now weak up to or above the present average. (See charts 51 and 29.) The position of the fifty-three teachers * (chart E) represents as nothing else could the value of the instruction received in the common and high schools in which they were trained, of which Mr. Wheelock says the results are "not much of anything." On this chart we find *five* individuals *above the eighty-five-per-cent line*, while chart 51 shows *nineteen higher than eighty-five per cent* and only *two below* the *average line*, as compared with *sixteen below* in the *former group*.

The unsatisfactory condition mentioned by the Regents' Head Inspector is due almost entirely to the methods of examining

* This group may not represent the average standing of teachers at all, and it is only just to the many noble workers in the field of education to state that, so far as measured, all having charge of classes averaging over thirteen years of age range between eighty and ninety-five per cent, as the successful in all vocations do.

drawing. Teachers will teach for that which the examiner seeks, and the drawings shown will be as free from error, as neat and clean, as the spelling would be under the same plan of examination, and have no more educational value. The ability to locate correctly is the foundation of success in free-hand drawing, and to a great extent in all the graphic arts. It can be as well tested in five minutes as in fifty. A glance at line 1, eighth year, shows that if the teacher has *lent no greater aid* to the class than *sustaining the attention* during the exercise, the drawing that would without that aid be so badly located as to be almost unrecognizable may be made to appear on the eighty-five-per-cent line, ten per cent better than the average adult unaided would make it. That this is true will be recognized by all teachers who have studied the exhibitions of pupils' drawings where a whole class *seems* to do excellent work. Sustaining the attention of the pupil is invaluable in instruction; by its power the child of any age above eight may learn as much fact in two minutes as the average adult can *unaided* in fifteen (see lines 1 and 2), but sustaining the attention makes *voluntary effort unnecessary*; that which makes conscious effort needless makes it *impossible*. The power to direct the attention unaided by outside stimulus becomes atrophied, observation impossible. The use of transparent planes, the theory of perspective, and all devices by which "drawing is made easy," only serve to rob it of educational value by putting the child in possession of technical tricks which make *observing* facts of no account.

Having the child draw the familiar object from Nature is another fatal mistake. The familiar object and language co-ordinate to perfection. The child may study and try to represent the difference between *two* objects as seen without danger, but he will correctly describe that in language long before he can graphically, because he can, while looking, put what he sees into words; but to draw, he must look at a blank page and recall, what? The strongest impression, whether because of the recency, frequency, or intensity of it. I have known the recall to reach back a whole week, a month, three months, because of the greater intensity put into some former effort to observe objects associated with those to be represented, the concept of which the pupil, though fourteen years of age, was powerless to inhibit. It is to this inability to indefinitely continue the inhibition of the conceived thing, rather than to lack of knowledge or defective vision,* that most

* Lucien Howe, M. D. (Popular Science Monthly, August, 1895), seems to think that eyesight plays an important part in accuracy as seen in drawing. The facts do not sustain the idea. A gentleman who has drawn the test twenty times, with an average error for each location of ·075 of an inch, on one occasion made an error of only ·033 of an inch, 1·5°, and at this time it was discovered that so considerable was the astigmatism of his

of the local errors seen in the works of many masters, old and modern, may be attributed.

If the free-hand drawings were set aside or destroyed as soon as made, it would remove the temptation that now exists to waste time in technical finish that might to the pupil's lasting benefit be spent in new effort at discovery, discriminating differences in various inclosed areas, values, or colors.

We might then come to be able to see the beautiful in Nature spread at our feet, and in common things at our very door, and not as now, under the name of *art*, hew down the mind of the rising generation to the narrow notion that the beautiful must be sought only on the canvases and in the conventionalities of the past or present age of interpreters, however exquisite or grand their works may be.

PRINCIPLES OF TAXATION.

By DAVID A. WELLS, LL.D., D.C.L.,
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XI.—THE EXISTING METHODS OF TAXATION.

SUBJECTS OF TAXATION.—The subjects of taxation, to use a happy generalization of Justice Field of the United States Supreme Court (Foreign-held Bond Case, 15 Wallace), "are persons, property, and business. Whatever form taxation may assume, whether as duties, imposts, excises, licenses, or direct, it must relate to one of these subjects. It is not possible to conceive of any other, though as applied to them taxation may be exercised in a great variety of ways."

With this postulate we are legitimately led up to the consideration of the ways or methods by which the State or Government, in virtue of its sovereignty, and on the ground of necessity, and solely for its support, taxes or compels contributions from the three above-enumerated subjects, for the purpose of defraying its expenditures.

APPORTIONMENT OF TAXATION.—This department of the subject of taxation, while the most practical and therefore the most interesting, is at the same time the one most obscure, and the one about which there is the most striking difference of opinion among writers on economic and fiscal subjects. The four maxims or canons laid down by Adam Smith in his Wealth of Nations, by

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right eye, which was chiefly used, that when looking at a pinhole ten inches off he saw two, about one tenth of an inch apart, and between these several more, yet the accuracy obtained was the highest ever recorded—98·34 per cent.

reason, as he claims, of their eminent justice and equality, have obtained such world-wide celebrity that they are almost always referred to as of unquestionable authority in all discussions of this subject, and have been thus characterized by an eminent French student and writer (M. Menier) on taxation: "When a legislator," he says, "brings forward a new scheme for taxation, he is always careful to say that it *is not* in contradiction with even one of these rules; and at the same time he never fails to invoke them as authority during a debate, even when he is actually scheming to transgress them."

These rules are four in number, and are as follows: 1. "The subjects of every state ought to contribute to the support of the Government, as nearly as possible, in proportion to their respective abilities—that is, in proportion to the revenue which they respectively enjoy under the protection of the state." In the observation or neglect of this maxim consists what is called the "equality or inequality of taxation." 2. "The tax which each individual is bound to pay ought to be certain and not arbitrary. The time of payment, the manner of payment, the quantity to be paid, ought all to be clear and plain to the contributor and to every other person. The certainty of what each individual ought to pay is, in taxation, of so great importance that a very considerable degree of inequality (I believe, from the experience of all nations), is not near so great an evil as a very small degree of uncertainty." 3. "Every tax ought to be levied at the time and in the manner in which it is most likely to be convenient for the contributor to pay it." 4. "Every tax ought to be so contrived as both to take out and to keep out of the pockets of the people as little as possible over and above what it brings into the public treasury of the state."

But although almost universally accepted as the embodiment of the highest wisdom, the above four maxims or canons of Adam Smith have been and are, nevertheless, open to some criticism. In the first place, they are so general in their nature and so lacking in any precise rule or test for application, that they stand in the light of aphorisms; somewhat as the maxims "Honesty is the best policy," "Never put off till to-morrow what can be done to-day," etc., to which all respect is always given, except the desirable one of practical use in actual cases. In fact, the originators of the very worst forms of taxation now existing might and probably would plead that their methods or practices were based on the ideas of Adam Smith, or were as near in conformity to them as was possible under the existing circumstances. Again, the first maxim or canon embodies two propositions antagonistic to each other, and one of which can hardly be considered correct; namely, that every citizen should pay taxes for the support of

the Government in proportion to his ability. For if, as almost all authorities are now agreed, taxes are the compensation which persons or property pay to the state for protection, then it of necessity follows that where there is no protection, ability is no just guide for assessment. "Where there is no protection," said Judge Story (in the case of United States *vs.* Rice, 4 Wheaton, 276), "there can be no claim to allegiance or obedience." And that Adam Smith did not intend to have his first proposition fully accepted would seem evident from the circumstance that he added to it, and qualified it with these other words, "that is, in proportion to the revenue which they [the citizens] respectively enjoy under the protection of the state." Montesquieu, who wrote at an earlier date, also enunciated even more clearly this common-sense and equitable principle, when he said (see Spirit of the Laws), that "*the public revenues ought not to be measured by the people's abilities to give, but by what they ought to give.*" "And what they *ought* to give," as has been remarked by another writer, "can, of course, be only measured by the benefit they are to derive."

DISCRIMINATING TAXATION.—The proposition that "the subjects of every state ought to contribute to the support of the Government in proportion to their respective abilities" embodies also, and inferentially favors the policy of discriminating taxation, and finds popular expression and justification in the assertion that the rich man needs more protection from the state than the poor man, has more interests to be guarded, and it is therefore right that he should pay more in proportion to his fortune. "It is just," says Sismondi, the Italian economist, "that all should support the Government in return for the protection it gives to their persons and properties, in proportion to the advantages society guarantees to them, and the expenses which it incurs on their account." But the question is pertinent, to whom or to what class of its members does society afford the most protection or render the most service? Is there any standard by which such proportionality can be even approximately determined? To these questions Mr. John Stuart Mill has made the following answer:

"It can not be admitted," he says, "that to be protected in the ownership of ten times as much property is to be ten times as much protected. Whether the labor and expense of the protection, or the feelings of the protected person, or any other definite thing be made the standard, there is no such proportion as the one supposed, nor any other definable proportion. If we wanted to estimate the degrees of benefit which different persons derive from the protection of Government, we should have to consider who would suffer most if that protection were withdrawn; to

which question, if any answer could be made, it must be that those would suffer most who were weakest in mind or body, either by nature or by position. Indeed, such persons would almost infallibly be slaves. If there were any justice, therefore, in the theory of justice under consideration, those who are the least capable of helping or defending themselves, being those to whom the protection of Government is the most indispensable, ought to pay the greatest share of its price; the reverse of the true idea of distributive justice, which consists not in imitating but in redressing the inequalities and wrongs of Nature. Government must be regarded as so pre-eminently a concern of all that to determine who are most interested in it is of no real importance. If a person or class of persons receive so small a share of its benefit as make it necessary to raise the question, there is something else than taxation which is amiss, and the thing to be done is to remedy the defect instead of recognizing it and making it a ground for demanding less taxes."

M. Menier, of France, widely known as a manufacturer of chocolate, but who has shown himself to be an economist of repute and a most valuable member of the French Chamber of Deputies, in a comprehensive treatise on taxation (*L'Impost sur le Capital*, Paris, 1874; English translation, London, 1880) re-enforces the conclusions of Mr. Mill respecting the popular theory of discriminating taxation by different though not less forcible arguments and illustrations, taking as a text the following remark of M. Léon Faucher, another distinguished French writer on economic subjects: "It seems just that he who, thanks to his talents, to his property, or his capital, procures for himself and his family the enjoyments of luxury should pay to the state a tribute proportionately more considerable than he who has only the produce of his daily labor to nourish and bring up his family." "To those," says M. Menier, "who do not reflect, nothing seems more simple than this proposition. A minimum of wants is spared taxation. In proportion as income increases the tax increases. Let us see the consequences.

"A principle is or is not. A principle recognized as true ought never to be given up, whatever may be its apparent dangers. Once admitted, it must be submitted to, followed out to the end, and its consequences accepted. If by following out its consequences we perceive that we are getting at the absurd, we must return to the principle, and subject it again to the touch of observation. There are many who content themselves with stopping halfway, not daring to advance, and afraid to turn back to discuss the principle on which they have long relied. They are the inventors of compromises, who adjourn questions instead of solving them.

"But taxation, it is claimed, may be 'wisely progressive.' I

know no more concerning a 'wise progression' than I do about a 'wise addition' or a 'wise multiplication.' A progression is or it is not. If it is insignificant, then it is a delusion. The inequality it aims at destroying subsists intact. If a true progression in taxation is established, here are the results we obtain: We will suppose, for example, that the tax ought to be trebled when the income is doubled; then a tax of 10 francs on 100 francs of income would rise to 200 francs on 2,000 francs, to 600 francs on 4,000 francs, to 1,800 francs on 8,000 francs, to 5,400 francs on 16,000 francs, to 16,200 francs on 32,000 francs, to 48,600 francs on 64,000 francs, and to 145,000 francs on 128,000 francs. I conclude that the principle that ends in such a consequence can only be false. What! the tax would one day exceed my fortune! I should be the debtor of the fiscal system that had absorbed more than my revenue. Then it would be for my interest not to augment it! I shall have accumulated only for the treasury, and the more I acquire the more rapidly I shall be despoiled. . . . That system may suit Utopians and retrograde people who completely absorb the individual in the state, but it will not suit those who, relying on facts, think the greatness and wealth of the state ought to proceed from the development of individuals. It may suit those who seek equality at the basis, but not those who seek equality at the summit. The theory of progressive taxation is a vestige of the old prejudice that regarded wealth as an evil, as a sort of theft from the rest of the country, and that it would be equitable to make the rich man atone or make reparation for the possession of his fortune and his pleasures. In warlike civilizations, where wealth was based on violence, it is not difficult to understand the legitimacy of this prejudice; but it finds no warrant in our industrial civilization, where all wealth, to be legitimate, must be based on the appropriation of natural agents to our wants. But the partisans of a wise progression in taxation have found means of escaping from the absurdity of the above consequence—namely, confiscation. They propose that above a certain figure the progression shall stop. Under such a system they would favor him who has but little money; but they would favor still more him whose wealth exceeds a certain limit. If you have £4,000 a year, you pay the maximum of the progression; if you have more than £4,000, the progression vanishes. A principle which ends in such consequences does not exist."

M. MENIER'S RULES.—To establish a system of taxation which will be equitable and effective without involving the principle of progressive or discriminating taxes, M. Menier regards the following constructive rules as fundamental:

1. Taxation should never be laid on circulating capital, "since every tax that obstructs circulation impedes production in a geo-

metrical ratio." 2. Taxation should be levied on the commodity; never on persons. 3. Taxes should never impede the liberty of labor. 4. Every tax ought to be levied as cheaply as possible. 5. There should be but one sole and single tax—namely, on *fixed capital.**

THE TRUE MEASURE OF THE BURDEN OF TAXATION ON PRODUCTION.—In addition to the maxims, or canons, proposed by Adam Smith, another one, first pointed out by Mr. Edward Atkinson, of Massachusetts, is worthy of being added, and may even be regarded in the light of a fundamental principle; and that is, *that the burden or injurious effect of a tax on production or exchange is not to be measured by the ratio which the tax may bear to the gross value of the subject of taxation, but rather by the proportion which the tax bears to the profit which might normally or naturally result from undertaking a certain line of industry or product.* To practically illustrate this, let us take an example. Let us suppose two men, A and B, to start shops for the manufacture of machinery, each with a capital of $20,000, and that each in his operations expends $20,000 for coal and iron, $40,000 in wages, and $4,000 for transportation of the raw materials to the shops for manufacture. The total cost of the annual product of each shop will then be $64,000, or a little more than three times the capital; and a sale of their respective products, at the net price of $66,000, would yield the owners $2,000, or ten per cent profit. Now, suppose further that under such conditions A has a tax imposed on him of three and an eighth per cent upon the value of his product; it may be a customs or excise tax, or an increased rate of railroad freight. This amounts to $2,000 on the $64,000 of product—no excessive burden, it may be said, and only requiring A to sell his $66,000 for $2,000 additional. But suppose A can not get this $2,000 additional; and he certainly can not if the other man, B, is exempt from this three-and-an-eighth-per-cent tax, or contrives to evade it, and competes with A in the open market. Then, in such a case, this three-and-an-eighth-per-cent tax upon product manifests itself as ten per cent upon the entire investment and absorbs the entire profits which otherwise might have been realized; so that the business of A first drags, then stagnates, and

* M. Menier defines fixed capital as every utility of which the product does not change the identity, as useful machines, instruments of trade, profitable buildings, improvements of land, and the like. Circulating capital, on the other hand, produces utility only by being transformed. It is represented by three elements—materials, goods, money. "Facts prove that the suppression of circulation is a cause of ruin for the land as for every other source of production. Look at Spain since the expulsion of the Moors, who had carried to so great a height the theory and practice of agriculture. The land, having become the property of a few great families or the clergy, was consolidated. Its circulation ceased completely, and production ceased with it."

is finally abandoned; while his workmen are discharged, the village where the shop is located runs down, the artisans, shopkeepers, and professional men connected with it complain of hard times and emigrate from the locality or the country, while the railroad fails to confer all the benefit to the community or profit to its stockholders that might be possible. B, on the other hand, exempt from the tax, keeps on working, and when hard times come continues his sales and the occupations of his workmen by taking *five* per cent profits instead of *ten*, and selling his goods, as he can afford to, at reduced prices to meet temporary conditions. Actual practical illustrations of the injustice and disaster consequent on such discrimination in respect to tax burdens and exemptions are afforded on a small scale in the history of much railroad management, and to a larger extent where two nations with different systems of taxation undertake to compete with each other in the sale of the products of their labor in the common markets of the world. We find here an explanation also of the immediate beneficial effects which attended the first tentative measures of reform in the British tariff instituted by Sir Robert Peel in 1842 and 1845, which, although consisting mainly in the removal of numerous small but obstructive duties, nevertheless started British industry forward by leaps and bounds, even before the larger burdens of tariff restrictions were removed in later years.

As the characterizations of "poll," "head," or "capitation" taxes, the only possible form of *direct* taxation on a person, and of the advantages and disadvantages of indirect taxes, through the agency of which the Federal Government collects the largest proportion of its revenues, have been already pointed out, the field of discussion under this head is practically limited to the existing methods of State or local taxation on property and business, in contradistinction to national or Federal taxation, or to the system under which nearly six tenths of all the contributions which the people of the United States make for the support of their governments are assessed and collected.

In Great Britain about two thirds of the revenue of the kingdom is from "local" in contradistinction to "national" taxation —£53,000,000 in 1890. Of this amount some £32,000,000, or about three fifths, is raised by rates on the annual value of land and house property in various localities. The next largest source of local revenue is from tolls, dues, etc., from docks, piers, harbors, ferries, and markets, and yields over £7,000,000, or thirteen per cent of the total. The total expenditures for local purposes in 1890 were returned at £67,000,000; the difference between local expenditures and receipts being made up by contributions or grants from the inland revenue department of the kingdom and by municipal loans. The aggregate *local* debt of the kingdom is

about one third of the national debt, and has been mainly incurred for municipal and urban improvements, such as water and gas supply, markets, tramways, parks, libraries, public baths, wash houses, drainage, and other improvements. The purposes for which the proceeds of local taxes are expended in the United Kingdom are mainly for poor relief, gas and water supply, schools, police, asylums, etc. In a report made to the British Association for the Advancement of Science in 1870 by Mr. Stanley Jevons, it was stated that the methods by which the local taxes of the kingdom were then levied were substantially according to an act passed in the reign of Elizabeth.

POPULAR THEORY OF TAXATION IN THE UNITED STATES STATED AND EXAMINED.—The general idea which constitutes the basis of the system of State or local taxation mainly recognized in the United States (though not in other countries), and generally known and designated as "*the general property tax*," is founded on the assumption that, in order to tax equitably, it is necessary to tax everything; the term *everything* being at the same time used in a sense so indefinite as to embrace not merely things in the nature of physical actualities other than persons, but also persons, incomes, rights, representatives of property, titles, trusts, conclusions of law, debts, and in short any act of assessing capable of resulting in the obtaining of revenue. As a logical consequence of this idea, the exemption of anything from taxation is furthermore held to be not only impolitic, but unjust, and if made necessary by circumstances, as something to be regretted.

The general property tax for general State purposes exists in all but four of the States of the Federal Union—Delaware, New Jersey, Pennsylvania, and Wisconsin. In Delaware there has been no property tax since 1877, as its expenses are defrayed mainly by licenses and taxes on railroads. In New Jersey there is only a school tax on property, but no property tax for general State purposes. In Pennsylvania the State tax is levied only on personal property. In Wisconsin the so-called State tax is levied only to defray the interest on the debt, and for the purpose of contributing to the university (one eighth mill tax), schools (one mill tax), and expenditures on account of the insane. But there is no property tax for general purposes. In addition to these four cases a property tax is levied in Vermont only in case the corporation taxes do not suffice to pay the entire expenses of the State (Seligman, Financial Statistics of the American Commonwealths, 1889).*

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* The statutes of Massachusetts enacted for making this system of taxation effective, and which have been substantially adopted by most of the States of the Federal Union, thus specify the objects, persons, and property that shall be subject to taxation:

Equally popular and plausible is the argument by which this assumption, and the administrative system based upon it, is upheld and defended. "Is not all property," it is asked, "either directly or through its owner, protected by the state or sovereignty?" "Do not all persons owe allegiance to the state?" And if so, "why should not all persons and property contribute to the requirements of the state for revenue in proportion to their ability?"

But, popular and plausible as are the arguments and assumptions for such a system of taxation, which, in the case of the United States, has been made operative under State, municipal, and local governments over the persons, property, and business of over seventy millions of people, and fortified by a vast amount of adjudication, it will require but little investigation and analy-

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SECTION 1. A poll tax shall be assessed on every male inhabitant of the Commonwealth above the age of twenty years, whether a citizen of the United States or an alien.

SEC. 2. All property, real and personal, of the inhabitants of this State, not expressly exempted by law, shall be subject to taxation.

SEC. 3. Real estate, for the purpose of taxation, shall include all lands within this State and all buildings and other things erected on or affixed to the same.

SEC. 4. Personal estate shall, for the purposes of taxation, include goods, chattels, money, and effects, wherever they are, ships and vessels at home or abroad, money at interest, and other debts due the persons to be taxed more than they are indebted or pay interest for, but not including in such debts due any loan on mortgage of real estate, taxable as real estate, except the excess of such loan above the assessed value of the mortgaged real estate, public stocks and securities, bonds of all railways, including street railways, stocks in turnpikes, bridges, and moneyed corporations, within or without the State, the income from an annuity, from ships and vessels engaged in foreign carrying trade, and so much of the income from a profession, trade, or employment as exceeds the sum of two thousand dollars a year; but no income shall be taxed which is derived from property subject to taxation.

The statute exempts from taxation the property of the United States and of the State; of the literary, benevolent, charitable, and agricultural institutions or societies incorporated within the State; all property of the common school districts; the household furniture of every person not exceeding one thousand dollars in value, and wearing apparel; farmers' utensils, not exceeding three hundred dollars in value; houses of religious worship; mules, horses, and neat cattle less than a year old; swine and sheep less than six months old; and "the polls and estates of persons who by reason of age, infirmity, and poverty are unable to contribute fully to the public charges."

"No ship or vessel, unless actually engaged in foreign trade, or in part undergoing repairs, shall be deemed to be engaged in such trade."

The statutes of the State of New York to the same effect are more concise, but equally comprehensive. They provide:

1. "All lands and all personal estate within this State, whether owned by individuals or by corporations, shall be liable to taxation, subject to the exemption hereafter specified.

2. "The term 'personal estate' and 'personal property' shall be construed to include all household furniture, moneys, goods, chattels, debts due from solvent debtors, whether on account, contract, note, bond, or mortgage, public stocks and stocks in moneyed corporations; they shall also be construed to include such portion of the capital of incorporated companies, liable to taxation on their capital, as shall not be invested in real estate."

sis to satisfy any one who can divest himself from the influence of old prejudices of the truth of the following propositions: *First*, that the assumption that it is necessary to assess everything in order to tax equitably involves an impossibility, and therefore unavoidable inefficiency, injustice, and inequality in administration; *second*, that, as popularly used in respect to matters pertaining to taxation, the term *property* is made to apply equally to entities and to symbols or non-entities, which is in itself an absurdity; and, *finally*, that the outcome of all this is a system which powerfully contributes to arrest and hinder natural development, to corrupt society, and is without a parallel in any country claiming to be civilized. And, in illustration of this latter point, it may be added that, notwithstanding recent discussions and publications, this whole subject is yet so unfamiliar to the people of the United States that probably nine out of ten of its best-informed and collegiate educated citizens, and even members of the bar, take it for granted that the method of assessing and collecting taxes for local and municipal purposes is substantially the same all the world over; and would be greatly surprised to find on investigation that the American system is one of the things that is exclusively American and so little esteemed by the people of other countries as to be for such reasons strictly "non-exportable."

TAXATION OF REAL ESTATE.—Attention is first asked to the defects of this system in respect to the taxation of real property. Here everything, as the term implies, is real, tangible, visible; something which can not be concealed; something which can not, under any circumstances, be removed beyond the jurisdiction of the State, except by transfer to the Federal Government; something concerning which the laws and decisions of the courts harmonize rather than conflict. In the valuation of real property, furthermore, it is possible to apply such tests and verifications as will restrict the errors of estimate within comparatively narrow limits. It would also seem as if the law as it exists upon the statute books of most of the States was sufficiently clear and explicit in its declaration and mandate. Thus the language of the statute of the State of New York is as follows:

"All lands within this State, whether owned by individuals or corporations, shall be liable to taxation. The term 'land' shall be construed to include the land itself, all buildings, structures, substructures erected upon, under, or above, or affixed to the same; all wharfs and piers; all bridges; all telegraph lines; all surface, underground, or elevated railroads and the iron thereon; all mains, pipes, and tanks laid or placed in, upon, above, or under any public or private street or place; all trees and underwood growing upon land; and all mines, minerals, quarries, and fossils in and under the same."

In most of the States of the Federal Union the tax laws require that the assessment of all property shall be at its full and fair cash value; and the judicial authorities of the United States have furthermore held that the requirement of approximative equality inheres in the very nature of the power to tax, irrespective of any constitutional or statute provisions.

In the State of New York each assessor on the completion of his official labors subscribes an oath of which the following is the material portion:

"We do severally depose and swear that we have set down in the foregoing assessment roll all the real estate in ———, according to our best information, . . . and that we have estimated the value of said real estate at the sums which a majority of the assessors have decided to be *the full value thereof.*" And the law further provides that "every assessor who shall willfully swear false in taking and subscribing said oath, shall be guilty of and liable to the penalties of willful and corrupt perjury."

It is difficult to see how language, other than this, could be made more clear and explicit; and it is accordingly evident that if the law fails in its execution, as it certainly does, the fault is not in the statute but in its administration.

Let us now see what are the acknowledged facts in respect to the valuation of real property in New York and other States where the observance of substantially like conditions are imperative.

In some instances in New York the valuation of real estate for taxation is reported as low as twenty per cent of its real value. In a majority of cases in the country the rate varies from twenty-five to thirty-five per cent, and rises in the cities to fifty and possibly sixty per cent of the maximum. In one case, mentioned in the report of the State assessors in 1879, two adjoining counties of the State made a difference of twenty thousand dollars per mile in assessing the same railroad. In short, there can not probably be found a single instance in the whole State, unless possibly in the case of certain unoccupied lands, the property of non-residents, where the law as respects the valuation of real property is fully complied with, and where the oaths of the assessors are not wholly inconsistent with the exact truth. The official reports of other States abound with like reports of flagrant inequalities in the assessment of real property. As a rule, where assessors are dependent for their tenure of office on political favoritism, there is no pretense, notwithstanding their oath, of complying with the law.*

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* "The strife between counties to reduce assessments has not ceased, and in all probability will not as long as assessors are elected, or selfishness be a passion in the human breast."—*Report of the California State Board for the Equalization of Taxes, 1885–'86.*

When, as is often the case, a State tax is apportioned to the several counties of the State, and by the counties to their respective towns, there arises a double competition between assessors of counties in the aggregate and of the towns for making the lowest possible valuation of property, especially real estate.

In a large number of States (twenty-one in 1890) an attempt has been made to correct the undervaluation of property rightfully subject to taxation by creating boards of equalization, with power to raise or lower the valuations of county officials, with a hope of securing substantial uniformity; but this measure has not been successful, and the most intelligent members of such boards have recorded their opinions that it is impossible under the present system to effect any just distribution of the incidence of taxation.

"SOME UNRECOGNIZED LAWS OF NATURE."*

By C. HANFORD HENDERSON.

IN Some Unrecognized Laws of Nature, Mr. Singer and Mr. Berens have restated the riddle of the universe, and have made a brave attempt to solve it.

It has not been the good fortune of modern science to give us a coherent philosophy of things so much as it has been to give us a very nice measurement of them. Its triumphs have been for the most part quantitative. "We have only so much science as we have mathematics." One might almost say that science has become a branch of applied mathematics. In the case of the luminiferous ether, and in some other departments of physical inquiry, one might even go a step further, and assert that science *is* mathematics, pure and simple, dealing only with signs and symbols, and quite unregardful of the realities of experience. Brilliant and successful as this treatment has been, it does not satisfy all the demands of the spirit. The old sense of wonder and inquiry is still unappeased. One is often tempted to stop in the midst of one's measuring rods and balances, and put again the old question, the eternal Why?

It is this sentiment which makes us turn with some eagerness to such a book as the one before us. It is an inquiry, not into the phenomena of Nature, but into their causes, and more particularly into the cause of gravitation. At the present time, we have no theory of gravitation. The several guesses that have

* Some Unrecognized Laws of Nature: An Inquiry into the Causes of Physical Phenomena, with Especial Reference to Gravitation. By Ignatius Singer and Lewis H. Berens. Illustrated. New York: D. Appleton and Company, 1897. Pp. 511. Price, $2.50.

been made at it, have never been taken seriously enough to merit the name of theory. With the strictly orthodox, indeed, the cause of gravitation is no longer open to discussion. It has been relegated once for all to the region of the unknowable. A book, therefore, which throughout five hundred pages not only proposes to discuss this forbidden problem, but also professes to solve it, will attract attention for its boldness, if for nothing else. One begins to read with large sense of expectation.

The volume is divided into four books, which deal respectively with methods of inquiry; with first principles; with phenomenology, or "the interconvertibility of forces"; and finally with gravitation. All the books seem to us of value. They have been arranged with considerable cleverness, for the effect is cumulative.

The first book is largely psychological. Its main content has to do with methods of inquiry and of verification, and with sources of error. It maintains, and we think very properly, that our greatest need at the present time is a revision of our conceptions rather than any further confirmation of our observational or experimental data. In all cases the causes of phenomena are inferential, and are necessarily colored by our prior conceptions along the same lines of inquiry. Our stock in trade, when we come to philosophize, is simply the report of our own imperfect senses, helped or hindered, as the case may be, by our equally imperfect reasoning. The same facts may come into different minds, but they have far from equivalent values. It is comparatively easy to agree about the facts, but far from easy to agree about their interpretation. The interpretation is necessarily subjective, and is conditioned by many factors outside the phenomena themselves. Remembering this, one will be disposed to agree with the authors that apparent absurdity is not a legitimate refutation of any new and strange theory. It is only the absence of similar conceptions that makes the new view absurd. Nor does the correspondence of any theoretical view with prior conceptions offer the least confirmation of the view itself. Its agreement with preconceived ideas may prevent its seeming absurd, but does not prevent its being untrue. The so-called "confirmations" of philosophy and science will always bear re-examination, indeed demand such periodical re-examination, and the more so in proportion to their seeming certainty. The shores of the ocean of truth are thickly strewn with the wrecks of many a fair theory, as beloved in its day as the most cherished beliefs of our own day. Equally true is it that agreement between phenomena and theory, however perfect it may be, is not confirmation, for it is to be remembered that the theory itself was deduced from these very phenomena. The argument that such agreement constitutes proof

is very plain reasoning in a circle—from which Heaven defend us all, and particularly our neighbor! The only evidence of this sort that is confirmatory must be *a posteriori*. If, from the consideration of things in general, a universal principle is brought to light, then the agreement of subsequently discovered or subsequently considered phenomena with this principle is strong evidence in favor of the probable truth of the principle itself. These considerations apply nowhere perhaps with greater force than in the investigation of gravitation. The problem is practically where Newton left it, unless indeed it has been rendered even more difficult by our inheritance of debarring ideas. The concluding chapter of the first book is wisely given to a psychological study of the current view of gravitation. The basic principle is not far to seek. It lies in the doctrine that gravitation is proportional to mass, and that mass is constant. With this conception firmly fixed in the mind, the interpretation of the phenomena of gravitation becomes a foregone conclusion. Yet the present authors show that this conception is far from being a necessary deduction from the facts of gravitation, is indeed probably a false deduction. Their experiments and reasoning lead them to believe, and the belief is supported by other observers, that either mass is not constant, or else that gravitation depends upon other factors than simple mass and distance. This alternative, however, as we shall see, is merely verbal.

Many of the psychological considerations in this first book are very obvious, yet they are none the less necessary, and we commend most highly the skillful vestibule which Mr. Singer and Mr. Berens have constructed to their new Temple of Truth.

The second book has to do with first principles. These the authors find to be four—persistence, resistance, reciprocity, and equalization. The four primary principles represented by these terms are at the basis of the whole work, and of their truth and adequacy the authors express themselves as having no misgivings whatever. They believe that the entire phenomena of the visible universe can be explained by referring them to these principles.

The principle of persistence grows out of a consideration of Newton's first law of motion: "Every body perseveres in its state of rest, or of uniform motion in a right line, unless it is compelled to change that state by forces impressed thereon." This is, of course, only the principle of inertia, which is simply another, and it has always seemed to us an unnecessary, statement of the principle of causation. Nothing happens without a cause. It is perhaps well to emphasize this principle when fighting superstitions and other hobgoblins; but in an intelligent world it may be taken for granted as one of those primary conditions of thought which need neither statement nor discussion. The habit of speak-

ing of inertia as if it were a "property" of matter, and the use made of it in current mechanics, has long seemed to us mischievous. The present authors modify this law to read, "All matter tends to persevere in whatever state it may happen to be and to resist change." In this form the law is more catholic. By persistence the authors mean "the tendency of all matter to remain in any given state, even after the conditions are altered (i. e., a quality), while the term *resistance* is used to denote the *intensity* of this persistence (i. e., a quantity)." The gain is not simply one of terminology. It is a real gain, since it allows us to substitute a simple idea, that of relative persistence or resistance, for the somewhat complex and dissimilar ideas represented by such terms as impact, inertia, latency, conductivity, charge, etc.

The principle of reciprocity is founded on another dictum of Newton's, that "all reactions are mutual and are directed to contrary parts." This means very simply that every change involves at least two bodies, and that no body *acts upon* another, but rather that two or more bodies *react with* one another. This follows, indeed, from the principle of persistence. Since a change of state in any body can be brought about by external agencies only, it must follow that the persistence of this body can only be overcome by the expenditure of a certain amount of resistance on the part of the second or reacting body, and a corresponding change in its own state.

The two corollaries growing out of this law are also very important:

"1. Bodies can react with each other only when there is a difference of state in respect of any quality or tendency; and—

"2. The extent or intensity of the reaction will be proportional to this difference, and will cease altogether when relative equalization has been reached."

This second corollary really involves the fourth primary principle, that of equalization, in virtue of which all bodies tend to come to a common state, and the drama of the universe, the flux and flow of things, goes on eternally. It might at first seem that with the operation of this principle of equalization the universe would at last, like a spent clock, run down and stop. Such a view has indeed found expression in that modern and now famous doctrine, the dissipation of energy. A universe completely run down, a dead uniformity of condition, are among the striking spectacles of modern scientific speculation. It is not that we see any loss of action in the cosmic drama. On the contrary, it goes on unceasingly. It is only that a limited conception of the principle of equalization requires such ultimate uniformity. But there is another element that must needs be taken into consideration. The establishment of relative equilibrium

between any two bodies would at once disturb the equilibrium existing between them and other bodies, and so tend to produce an unending series of readjustments. Furthermore, equalization with respect to any one quality or tendency does not mean equalization with respect to all. We have thus a twofold source of variation, and the conception of eternal change becomes at once less impossible than the conception of eternal rest. In addition, the doctrine of the dissipation of energy involves a fatal contradiction. If the world be running down by the conversion of all available energy into heat, how comes it about that the universe is at the same time cooling off by the loss of heat? The answer that the heat energy is being transferred to the ether is not satisfying, and it is particularly unsatisfying if one does not believe in the ether. An examination of the phenomena would lead one to the very contrary conclusion—that the world machine is not running down and that the universe is not cooling off.

The third book, on phenomenology, starts out with the denial of "force" and "energy" as separate physical entities, and seeks to find an explanation of acceleration and retardation, heat and molecular reaction, electricity and magnetism, conduction and induction, in terms of persistence, resistance, reciprocity, and equalization. Energy is regarded not as a cause of phenomena, but as a result, while "force" is dismissed as a metaphysical pitfall which has already claimed too many victims. The attempt is necessarily somewhat lengthy (it occupies two hundred pages), and the more so since the milk of human kindness in these two writers has not yet been condensed, but in the main it is a very successful attempt. It proceeds upon the true scientific principle —the search for similarities rather than for differences.

The same book also takes up the much-discussed question of action at a distance. We all remember Newton's words: "That gravitation should be innate, inherent, and essential to matter, so that one body may act on another at a distance through a vacuum without the mediation of anything else, by and through which their action and force may be conveyed from one to another, is to me so great an absurdity that I believe no man who in philosophical matters has a competent faculty of thinking can ever fall into it." But experience shows that equalization between two bodies in different states of excitation takes place the more readily in proportion as the intervening resistance is less. It is a natural inference, therefore, that the very most favorable condition for such equalization would be the absence of all resistance—that is, the absence of any intervening medium. Experiments with vacuum tubes confirm this inference. The more perfect the exhaustion the more perfect the transmission; and this is true not only of heat, light, and electricity, but as well of gravity itself,

since bodies fall more readily *in vacuo* than in air. There is an important distinction between kinematic and dynamic reactions. The first, or primary reactions, not only can but always do take place at a distance, and in view of the undoubted fact any discussion of the possibility is idle in the extreme. But it is very different in the case of secondary or dynamic effects. There is, strictly speaking, no reaction between the bodies concerned. They have no attraction for each other. They merely happen to get in each other's way when one or both are undergoing some kinematic reaction. A falling body may meet a second body thrown upward, and the path of each will be notably altered, but the reaction will be purely dynamic, and as such absolutely dependent on contact. These secondary reactions happen to be the ones with which we are the more familiar and upon which we have allowed our minds to play the more freely. The old question, "Can a body act where it is not?" is only applicable to dynamic reactions, but is not at all pertinent in the discussion of kinematic reactions. In the first case, no one doubts the inability of a body to push or pull another without actual contact. In the second case, the facts leave no room for discussion.

The concluding book, on gravitation, is naturally the *pièce de résistance* of the whole, and seems to us of high interest and importance. The other books lead up to it very cleverly. Newton himself, as we have seen, had no theory of gravitation, or at least was extremely careful not to publish it if he ever had one. Later disciples, however, have been less cautious, and the Newtonian view has been erected into something of a theory. This assumes that all matter attracts all matter, and this quite independently of its state of excitation. The intensity of the attraction has been formulated in the well-known law that gravity is proportional to the mass and inversely proportional to the square of the distance. But mass, as Newton used the term, is synonymous with weight, and weight is simply the measure of gravity, so that this fine-sounding phrase amounts only to this, that gravity is proportional to gravity, a statement which can not be said to materially help on the cause of truth. The Newtonian view assumes the constancy of mass or weight, but does so without the least experimental verification, and indeed in the teeth of much contrary evidence. It is true that modern physicists distinguish between mass and weight, making the former term stand for amount of matter (whatever that may mean) and the latter for the measure of gravity. But in this sense mass is a purely metaphysical quantity.

Now, there are two classic experiments for determining the density of the earth that seem at first sight to establish the current view that all matter attracts all matter. These are the

Cavendish experiment, in which the attraction of lead balls of known mass is measured by means of a torsion balance, and so compared with the attraction of the earth; and the Schiehallion experiment, in which a plumb line is suspended near a mountain of known mass, and the deflection of the line from the vertical carefully measured. But both experiments proceed upon the assumption that all matter attracts, and prove nothing.

This review of the Newtonian conception serves as a preface to the authors' own theory, which is a direct outgrowth from the four primary principles deduced in an earlier book—persistence, resistance, reciprocity, and equalization. Briefly stated, their theory is that two bodies in different states of excitation and free to move will move toward each other, the intensity of attraction being proportional to the difference in the excitation. Bodies in the same state—that is, in equilibrium—have no attraction for one another, and there will be no gravitation manifested between them. This is a direct contradiction of the Newtonian position that gravitation is universal. The excitation of a body may be increased by heat, light, electricity, or magnetism, and consequently the attraction, weight, or mass may be changed by a change in the physical conditions. This has been repeatedly shown by experiment, but with the idea of the unchangeableness of gravity firmly fixed in the mind the results of the experiments have always been explained on other grounds. According to the new view, terrestrial gravitation is entirely due to the different states of excitation which prevail on the outside of the globe and on the inside, and notably to the difference in thermal condition. Heating a body on the surface of the earth ought, by lessening this difference, to reduce the attraction—that is to say, the weight—and such is actually the case. Every one who has worked in the laboratory knows that a hot platinum crucible weighs several milligrammes less than the same crucible when cold. This was formerly attributed to ascending currents of hot air, but the explanation no longer holds. These and other similar experiments have recently been repeated under conditions which do not admit the existence of convection currents, and the loss of weight is still observable.

With permission we quote from a letter recently received from Mr. Paul R. Heyl, of Philadelphia: "I have been making a curious experiment since I got back within reach of an analytical balance. I took a piece of three-quarter-inch glass tubing, sealed it at one end, and choked it slightly about one inch from the sealed end. In the lower chamber thus formed I placed dilute sulphuric acid, and dropped in a piece of solid caustic potash, which was arrested at the choke. I then sealed off the upper end of the tube about two inches above the choke. This arrangement I then

packed in cotton in a light glass cylinder, one and three quarter inches diameter by six and a half inches high, and closed the mouth of the cylinder by a flat cork carefully paraffined so as to be air-tight. The apparatus was then placed upright on the balance and counterpoised carefully. The balance beam was then lowered and the apparatus removed from the pan, held inverted for a second or two, and replaced on the pan. On raising the beam and releasing the pans a distinct *loss of weight* made itself immediately apparent, some seven to nine scale divisions. (The apparatus weighed from one hundred and ten to one hundred and twenty grains.) After some three quarters of an hour the normal weight returned.

"This loss of weight could not be due to the fact that I was weighing a vessel filled with air partially rarefied by the heat produced, for both vessels were closed air-tight. Nor could it be due to currents of hot air rising (the usual explanation in text-books) for two reasons: first, because the loss of weight was immediate, and, owing to the cotton packing, the outside of the apparatus did not become perceptibly warm to the touch for three quarters of a minute, and never became more than barely warm; secondly, because the effect noticed was *too great* to have been produced by convection. . . . It would seem, then, that convection currents have been greatly overestimated, and that the loss of weight noticed in weighing hot bodies is in large part a true effect. Either mass is a function of temperature, or else (which is more probable) heat weakens gravitation just as it weakens magnetic attraction, only that the magnetic attraction does not come back when the steel cools."

Furthermore, the authors show that the combining weights of the elements vary with the temperature, and they record a series of very interesting experiments. When applied to celestial gravitation, to the motion of the earth and other planets, and to their apparent irregularities, the new theory leads to surprising conclusions. If it stand the test of a more widespread examination, it will entirely change our conception of astronomical physics, and make necessary a radically different cosmology. The speculations in this department, however, are put forward very tentatively, and more by way of suggestion than as settled convictions. It will be noticed here, as elsewhere throughout the book, that the observed phenomena of Nature are not called in question, but only our conceptions and interpretation of them.

In conclusion—and it is quite time that we should stop—we are disposed to believe that Mr. Singer's and Mr. Berens's book is destined to attract wide attention, perhaps to provoke warm controversy, and certainly to stimulate wholesome doubt and inquiry. It has a high value quite aside from whether one accepts the

main conclusions or not, and we commend it to the serious consideration of those interested in the world-riddle. We can not forbear the remark, however, that even if we accept the conclusions, the cause of gravity is still to be sought. If we attribute it to the mutual attraction of bodies in different states of excitation, we have advanced a proximate cause for the attraction, but we have not explained why this is a cause or how it acts. We have but carried the inquiry one step further back.

"Veil after veil will lift—but there must be
Veil upon veil behind."

SCIENCE AT THE UNIVERSITY OF CHICAGO.

By Prof. FREDERICK STARR.

WHILE it is true that buildings do not constitute a university, it is also true that any description of science work at a university must give considerable prominence to buildings. Museums, laboratories, and observatories must be definitely constructed for the work which they are intended to perform; if there are peculiar and individual features in the instruction, some hint of these at least must appear in the structures in which this instruction is to be given. The buildings of the University of Chicago, with the exception of its astronomical observatories, are located upon a piece of ground in the southern part of the city, between Washington and Jackson Parks. These parks are connected by the Midway Plaisance, which, since the time of the World's Columbian Exposition, has been developed into one of the finest boulevards in the city. The property of the university fronts on this handsome driveway, and consists of four ordinary city blocks containing twenty acres. The portions of the streets intersecting this piece of ground have been vacated by the city, leaving the campus unbroken. Before a single building was erected the architect, Henry Ives Cobb, drew up a general study for the mass of constructions, which it is hoped will be finally erected. Ultimately the buildings will form a series continuous around the four sides of the campus, but with entrance ways at the middle of each side. In the great court thus inclosed will be separate buildings for museums, libraries, and laboratories. While some changes in the buildings thus planned have been necessitated, the idea in general has so far been carried out, and will be in the future. Many years must elapse before the plan is completely realized, but much has already been done. One temporary and sixteen permanent buildings have been erected;

of these seventeen buildings upon the campus, eight are specifically buildings for scientific purposes—Kent Chemical Laboratory, Ryerson Physical Laboratory, the four new Hull Biological Laboratories, Walker Museum, and Haskell Oriental Museum. All the buildings of the university are composed of the same material—a fine-grained gray freestone. Forming parts of one architectural design, all are built in one style, middle English Gothic. No two buildings are quite alike, but all are consistent, and produce, when taken together, a harmonious effect.

The Kent Chemical Laboratory was the first building devoted to science finished on the campus. It is the gift of Mr. Sidney A. Kent. In the hallway is a simple bronze portrait tablet bearing the inscription: "This building is dedicated to a fundamental science in the hope that it will be a foundation stone laid broad and deep for the temple of knowledge in which as we live we have life. —SIDNEY A. KENT."

FIG. 1.—PRESIDENT WILLIAM R. HARPER.

The arrangement and character of chemical laboratories are matters so definitely fixed by years of experience that few points of detail in reference to any one deserve mention. The Kent Laboratory is, however, well equipped for its work. In the basement are gas furnaces, seven in number, with air blasts for giving high temperatures. The ground floor contains lecture room, room for gas analysis, and rooms for advanced work in organic preparations. A chemical museum has been begun here which is to be greatly developed later. The second floor is devoted to research work and organic chemistry. Upon it also are the chemical library, combustion room, and sealed-tube room. Upon the third floor are the general laboratories for beginners, rooms for quantitative and qualitative analysis, dark room, etc. There are, of course, the usual store rooms and a balance room. In the building are six private laboratories for instructors, each completely fitted out. The head Professor in Chemistry, John Ulric Nef, has an excellent corps of helpers—Alexander Smith, Felix Lengfeld, Julius Stieglitz, and Richard S. Curtiss. The original work done by the force has been chiefly in the line of organic chemistry. Prof. Nef himself has conducted important investigations upon

nitro-methane and the cyanides. Fulminic acid, discovered in 1820, was first satisfactorily analyzed by him. Among his important studies are those in the direction of ascertaining the composition of bivalent carbon. Prof. Smith has rendered important

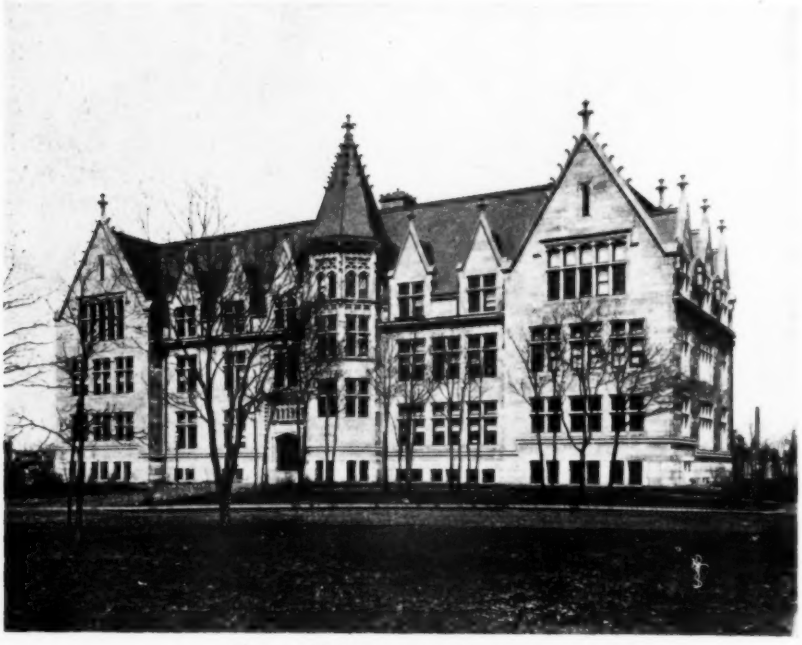

FIG. 2.—KENT CHEMICAL LABORATORY.

contributions to our knowledge of addition and condensation processes, while among the important works of Dr. Lengfeld and others of the staff are the obtaining of thiamines and other organic sulphur salts, studies upon rearrangement of molecules in compounds, hydrolitic dissociation of salts, and researches upon amydo-phosphoric acid, titanium and zirconium compounds. So far, however, nothing has been done in physical chemistry. No courses in that direction have been offered, and it is probable that none will be for some time to come. The department has no journal, but the results of the researches conducted here are published in the more important chemical periodicals, particularly in the American Chemical Journal, the Proceedings of the French and German Chemical Societies, Liebig's *Annalen*, and the *Compte Rendu*.

The Ryerson Physical Laboratory is unquestionably the best equipped and most handsomely finished building on the campus. Built by Mr. Martin A. Ryerson, of Chicago, to the memory of his father, Martin Ryerson, it was completed January 1, 1894. Externally individual and striking, its general character and

style harmonize admirably with those of the other buildings upon the grounds. It is, however, far heavier and stronger in construction than the others; the interior wainscotings are in marble; the first-floor laboratories are provided with piers of masonry in addition to the heavy slate wall shelves which are found throughout the other portions of the building. The object of this heavy construction is to minimize the jars and disturbances from outside, which would otherwise seriously interfere with the delicate manipulations to be conducted, and the minute movements and vibrations to be studied. One striking constructional feature which adds largely to convenience is the presence of ducts and channels between walls and in the floors, so that pipes can be laid from any part of the building to any other without difficulty. Elementary students work upon the third floor, senior college students on the second, while the first floor is devoted to research work. The more notable features of the department's work are naturally upon this floor. The

FIG. 3.—RYERSON PHYSICAL LABORATORY.

machine shop, under the direction of an expert mechanic with two trained men for helpers, allows the manufacture on the ground, under the eye of the investigator, of instruments needed in pursuing any study. This shop is fitted up with all needed machinery, supplied with power, and has connected with it a fully stocked supply room. Adjoining it is a students' work-

shop, where one pursuing special lines may make up his own instruments, construct his own machines, or devise models to be used as patterns in the machine shop proper. The power for the building is furnished by three dynamos and an engine located in the basement. An air compressor and a vacuum pump form part of the outfit. The laboratories are large, intended for several students working together, or small, for individual workers. At the present time, students are pursuing investigations upon the mechanical equivalent of heat and the coefficient of viscosity of a liquid. There are eight or ten of these individual laboratories for single students, each supplied with all needed facilities. Every laboratory room, large or small, is supplied with gas for light and fuel, electricity for light and power, water, compressed air, and vacuum pipes. In one of the two constant temperature rooms is a highly interesting piece of apparatus conceived by Prof. Michelson and perfected by Prof. Michelson and Prof. Stratton. Its purpose is the direct production of standards of length. The principle involved is the determination of the length of the metre in waves of light. This determination was first made by Prof. Michelson, whose original investigation was published by the Bureau Internationale des Poids et Mesures, at Paris. The instrument produces light waves, from a given substance, of known length, and then mechanically lays off standards of length, up to two decimetres, in waves of light. Another notably interesting piece of apparatus constructed by Prof. Michelson and Prof. Stratton is a *harmonic analyzer*, which has cost two years of work. A first pattern was quite fully developed, only to be abandoned for the design shown in the illustration on next page. The purpose of the apparatus is the analysis and synthesis of any harmonic curve (Fourier's series), provided not more than eighty elements enter into it. Every one knows the vast use made to-day of traced curves in all branches of science. These curves are frequently resultants and combinations of two or more simple curves. It is a matter of difficulty to recognize and separate the elements thus combined. The machine in question enables the

FIG. 4.—PROF. A. A. MICHELSON.

investigator to effect this decomposition and to prove it by mechanically reproducing the curve in question through combinations of the elements involved. The best way of showing the amount and character of the work done in this physical laboratory is to present a list of the researches completed or in progress during the year:

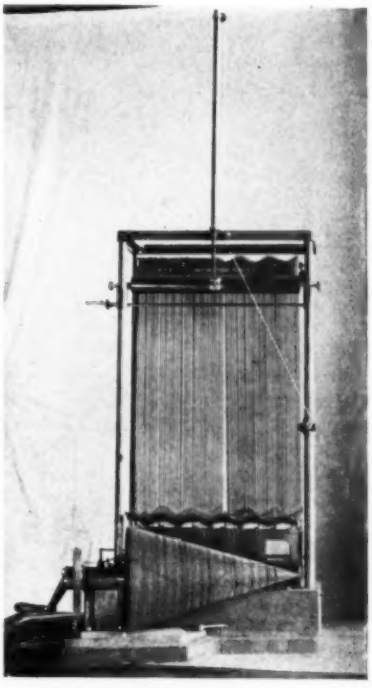

FIG. 5.—HARMONIC ANALYZER.

RESEARCHES COMPLETED OR IN PROGRESS DURING THE YEAR. —(1) Relative Motion of the Earth and Ether—Head Professor Michelson; (2) A New Harmonic Analyzer—Head Professor Michelson and Associate Professor Stratton; (3) Production of Standards of Length by Means of Light Waves—Head Professor Michelson and Associate Professor Stratton; (4) Attempt to Measure the Superior Limit to the Size of Molecules by Capillarity—Head Professor Michelson and Associate Professor Stratton; (6) Deposition of Metals in High Vacua by the Electric Discharge—Associate Professor Stratton and Dr. Mann; (7) Study of Electric Waves by Means of the Interferometer—Mr. Hull; (8) Coefficient of Viscosity—Mr. Johonnott; (9) Resistance of Thin Metal Films—Miss Isabelle Stone; (10) Mechanical Equivalent of Heat—Mr. Smith; (11) Application of Interference Methods to Spectroscopic Measurements—Mr. Rice; (12) Velocity of Cathode Rays—Mr. Morrison.

One of the most thoroughly organized scientific departments in the university is that of geology, under the direction of Prof. Thomas C. Chamberlain, who has associated with him seven helpers. Perhaps nowhere in America is this work so carefully divided. The broad way in which it is treated at the University of Chicago is indicated by the list of workers: In geology proper, Profs. Chamberlain, Salisbury, and Van Hise lay general foundations; Farrington in mineralogy, Iddings in petrography, Salisbury in physiography and geography, Weller in paleontology, Holmes in anthropic and graphic geology, and Penrose in economic geology form a strong corps of specialists. The department aims at systematic training in its subject, either in con-

tributing to a liberal education, or in preparing for professional and investigative work. The work is adaptable, ranging from undergraduate courses of the most elementary kind to the highest lines of seminar and field study. One feature demanding specific mention is the concentration of field work. While local field work is done in connection with the several classes, it is considered incidental; field work pure and simple is concentrated in consecutive and exclusive field investigation during the second term of the summer quarter. At that time the class is systematically organized and held constantly at work under the direction of an experienced field geologist. In all courses, whether in class room, seminar, or field, prominence is given to principles and working methods; special emphasis is laid on the philosophic phases of the subjects discussed; much attention is given to the treatment from historic and genetic points of view. Constantly and always the effort is to bring the student into relation with the living questions of the science, and to make him feel it as a growing body of truth. In connection with the department the Journal of Geology is conducted. It is a semiquarterly magazine, the actual editorship of which rests upon the geological faculty; the associate editorship is made up of the leading geologists of America and Europe. The important papers in its pages are mostly concerned with the present problems of the science. Among its most striking and valuable features are its Studies for Students, which are intended for advanced workers, and are full of the most important suggestions and help.

FIG. 6.—PROF. THOMAS C. CHAMBERLAIN.

The department of geology is housed in the Walker Museum, a three-story and basement building donated by Mr. George C. Walker. The policy of the university is not in the direction of gathering great museum collections in any line. The Field Columbian Museum, so promisingly started soon after the World's Columbian Exposition, is located near the university. Fully organized, it is being systematically developed in every line of science. Its proximity renders the gathering of great collections at the university unnecessary, as students have special facilities

furnished them by the museum. Collections, then, at the university will be chiefly formed with reference to their actual teaching value. The ground floor of Walker Museum is devoted to collections in mineralogy and geology, and the Ryerson collection of Mexican antiquities; the second floor is given up to the work of the department of geology, as already outlined; the third floor is chiefly devoted to work in anthropology. While the collections in geology present little of striking interest, they include the great series of fossils brought together by the late Prof. U. P. James, of Cincinnati, famous in American paleontology, containing great numbers of important specimens, and a particularly complete presentation of the fossils of the Cincinnati group (Lower Silurian). As stated, the work in anthropology is located on the third floor of the Walker Museum. It is fair to claim that at no other American institution is instruction work in anthropology so definite and at the same time so comprehensive, some eleven different courses in somatology, ethnology, and archæology being offered. Part of the space occupied is set aside for laboratory work. The instrumental equipment is nearly complete, although the material upon which to work is inadequate.

FIG. 7.—WALKER MUSEUM.

The charts and diagrams prepared by Dr. Boaz in connection with the World's Columbian Exposition, representing an enormous amount of investigation upon native American tribes and presenting it in graphic form, are the property of the university, having been originally drawn up at its expense; they form valuable aid to class and laboratory work. While not boasting a museum, the department has a considerable amount of material of its own from New Mexican Pueblos, Mexico, and Peru; it also

has the use of loan collections of objects from Mexico, the Aleutian Islands, the Utah cliff-dwellers, Japan, etc. The most important of these loans is the Ryerson collection from Mexico—a large series of antiquities gathered by Señor Abadiano, and forming an excellent general representation of Mexican archæology. No journal of anthropology is published, but a series of Bulletins has been started. These will be octavo publications in pamphlet form, presenting new material or results of investigations by instructors or advanced students in the science. Two have already been published, dealing with points of Mexican archæology.

The Hull Biological Laboratories are the newest buildings upon the grounds. They are the gifts of Miss Helen Culver, and are named in memory of her uncle, Charles J. Hull. They form a group of four buildings arranged with an inclosed court. The buildings are grouped into two pairs, the members of which are connected by covered passageways or cloisters. Biology and Botany are thus united, and Anatomy and Physiology. The Biological and Anatomical Laboratories are at the front of the group and are connected by a short passage surrounded by a rather striking entrance way. The four buildings themselves, while conforming in style to the rest of the university structures, have been erected with special reference to their intended use, and neither space nor light has been sacrificed to the demands of Gothic decoration. In the center of the rectangular area surrounded by these buildings it is planned to have a pond of water of considerable size for supplying material in the direction of pond life. The Zoölogical Laboratory is under the direction of Head Professor C. O. Whitman, and consists of four floors and basement. Connected with the latter is a greenhouse arranged for supplying light and dark conditions, also rooms for animals in captivity, and various workshops. On the first floor is the general laboratory for elementary students, the general biological library, and a museum of illustrative series of life forms. The remaining floors are given up to suites of rooms for the head professor and his assistants, and to research laboratories. When the university was founded, Prof. Whitman brought with him a force of instructors and advanced workers from Clark University, at which institution he had developed the work in zoology to remarkable completeness. The work begun at Worcester has been prosecuted at Chicago with diligence. Among the important researches here conducted by Dr. Whitman and by his helpers, William M. Wheeler, Edwin O. Jordan, Sho Watase, and others, are contributions to annelid morphology, molluscan morphology and structure, and the development of arthropods and invertebrates. Important work in the line of cellular biology has also been done. An investigation now being con-

ducted by Prof. Whitman himself will be of popular interest as well as of scientific importance—a study in pigeons. Prof. Whit-

FIG. 8.—HULL BIOLOGICAL LABORATORIES.

man is crossing wild forms and conducting experiments upon various species in captivity; a wide range of forms is used, includ-

ing species from Australia, Japan, South America, and other parts of the world. The east end of the fourth floor of the zoölogical building is devoted to the work in bacteriology. Prof. Jordan, who conducts this work, has a large laboratory and several smaller individual laboratories equipped with steam sterilizers, hot-air sterilizers, autoclavs, incubators, refrigerators, and all other necessary apparatus for culture and study of pathogenic bacteria and other germs. In connection with this work a Bacteriological Journal Club has been organized for reading and discussing the current literature of the field. On this floor, also for the present, are the quarters of Dr. Baur, Professor of Vertebrate Paleontology. The Department of Vertebrate Paleontology is under the direction of Prof. G. Baur. Before coming to the university Dr. Baur worked at Munich and afterward assisted Prof. O. C. Marsh at Yale. In 1891 he had charge of the Salisbury Expedition to the Galapagos Islands. His work at the university began at the founding of the institution in 1892. His courses cover vertebrate zoölogy and paleontology. Special reference is given to the great problems in taxonomy, distribution, and phylogeny. There are extensive collections for practical study from the South Dakota Miocene, the Wyoming Laramie, Kansas Cretaceous, and Texas Permian. No reference to Prof. Whitman's work would be complete which omitted the Marine Biological Laboratory and the Journal of Morphology, although neither is directly connected with the University of Chicago. The Marine Biological Laboratory at Woods Holl, Mass., is thoroughly and favorably known. Dr. Whitman is the director and has been indefatigable in its development. The work done there during the summer months is of the best. Students work in all grades, from elementary class work to the most advanced original research. Besides the laboratory work, which is of course the chief feature, series of lectures more or less popular but thoroughly scientific in character are given. The University of Chicago co-operates in these laboratories with the institutions of learning which have preceded her in their development. The Journal of Morphology, while not a university periodical, furnishes the natural medium of the original investigations there conducted. Dr. Whitman was connected with it before the university opened, and is still associated in its editorial management with Dr. Allis, of Milwaukee.

While the university has not yet a medical department, one of the new laboratories is arranged for anatomy. It is under the direction of H. H. Donaldson, Head Professor of Neurology. Among the features of the building is the handsome demonstration room. In this building also are two special lines of work of an interesting kind—viz., the work in neurology and that in experimental

psychology. The former is, of course, in Prof. Donaldson's hands. The department is equipped with all the necessary illustrative apparatus—diagrams, models, etc.; the laboratory is supplied with needed material and appliances. The courses offered are intended (*a*) to furnish an exposition of the architecture and functions of the nervous system; and (*b*) to offer opportunity for the investigation of new problems and critical discussion of current work in the subject. In the outline of courses reference is had to the importance of the anatomy and physiology of the nervous system to the student of medicine. Special study is attempted of the variations in intelligence correlated with the changes in the central nervous system (1) in the vertebrate series, (2) during the growth and development of any individual, and (3) as the consequence of disease or experimental injury; such variations have an importance which is psychological as well as biological. The study of the nervous system is capable of throwing light upon some of the questions of phylogeny, and emphasis is laid upon this fact.

Experimental psychology, which has assumed recently great prominence in the universities, is here in charge of Prof. James R. Angell. Two chief ideas are held constantly in view in the work: (*a*) to give thorough practical training for the carrying on of experimental investigation; (*b*) to directly conduct such investigation. The instrumental equipment is adequate, placing the university among the first half dozen in America. The new quarters in the Anatomical Laboratory furnish ample space for laboratory work, apparatus rooms, and lecturing. The relation between this work under Prof. Angell and neurology under Prof. Donaldson is naturally close, and the two work in harmony. In psychology proper no work in nervous anatomy is undertaken, but students are impressed with its importance and urged to pursue it in the other department. The nominal relation of the work is with the Department of Philosophy, and some of the results of research have appeared in the publication of the university entitled Contributions to Philosophy. The first number of this publication is, in fact, devoted to psychology. Among its contents the paper on Reaction Times is fundamental and perhaps the most thoroughgoing statement yet made in this direction, so far as the processes themselves are concerned. Much attention has been given to memory processes, especially the visual and auditory elements of such processes. The work upon simultaneous sensations—visual, auditory, tactile, electric—is perhaps the most careful yet made. The study of the psychology of attention has been much emphasized during the past year. An investigation, the results of which are just about to be published, upon the growth of habit is among the first on this subject to be pursued from the primarily experimental point.

Both in the thoroughness of its equipment and in the interest of the subjects to be studied no laboratory on the ground surpasses the physiological. It is probably the only building devoted entirely to this purpose in America, and in the completeness of its equipment it surpasses most if not all of the European institutions of its kind. It has the ordinary complement of lecture rooms, laboratories, libraries, and study rooms. One somewhat novel feature in the lecture room deserves notice. The space behind the professor's platform is occupied by blackboards, extending almost entirely across the whole side of the room. The black surfaces, however, are at two different levels, that directly behind the lecturer's desk being slightly higher than the other, permitting it thus to be rolled back in front of the other half, disclosing behind it a screen of ground glass for projection. The work of darkening and operating in projection is done in a small room behind this glass screen, thus preventing all noise and disturbance of the class in the manipulation. Certain peculiar features in the arrangement of the laboratory deserve special mention: (*a*) a greenhouse of fair size, divided into two sections, is intended for the rearing of insects and plants, supplying the opportunity for extended study of phenomena of life in the lower forms of animals and plants, for physiology can never be studied simply from animals, vital processes being comprehended only from a full survey of conditions found in all living things; (*b*) a large aquarium for sea life; the proper stocking of this will be a matter of time, but the keeping and observation of marine forms are important; (*c*) a cold storage room for the study of polar effects; (*d*) an arrangement of dark rooms with heliostat, prisms, etc., for studying the effect of monochromatic light upon living forms. The first of this series of rooms forms practically a vast spectroscope. The light is thrown from outside by a heliostat of the greatest perfectness of construction. It is received upon a battery of prisms, which can be controlled by connections in the next room. The light, when separated into rays of the various colors, is thrown through a slit in a connecting door upon the support on which rests the animal or plant under experimentation. This is in a little room so related both to the spectroscopic room and to the hinder and third room of the series that no unresolved light can gain access to it at any time unless desired. (*e*) There is also a room for the study of the influence of high temperatures. These five special features are both important and novel. In addition to them there are operating rooms, rooms for experiments in metabolism, physiology, chemistry, ordinary laboratory work, etc. The two rooms where higher animal forms—dogs, monkeys, rabbits, etc.—are kept in captivity are supplied with cages of the best construction, and are carefully arranged

for light, ventilation, and cleansing. All the ordinary laboratory rooms are supplied with aquarium equipment. The two chief designs of the laboratory may be categorically expressed: (1) to provide material for the extension of physiological investigation to the whole animal kingdom and even to the plant world; (2) to provide opportunity for studying the effect of all environmental conditions singly upon living forms. The importance of these is manifest. Physiologists have been too much inclined to learn their lessons from man alone, or from man and a few of the higher mammals. Certain processes, however, absent or obscure in man, are present or better defined in some other forms. Phenomena vary with types: one is at its best in one species, another in another; a wide range, therefore, of forms is necessary. In studying the effects of environment it is desirable, so far as possible, to isolate the elements of which it is composed. It is an easy matter to attribute an effect to the wrong factor in the surroundings. The Physiological Laboratory is in a sense an expression of its head, Prof. Jacques Loeb. Dr. Loeb was trained in the most important laboratories of Europe, and his investigations therein were of extreme interest. His study of heliotropism demonstrated that the tendency of plants to turn sunward was the same thing as the impulse which drives the moth to the flame; that there is no more psychical activity in the latter than in the former. His later investigations into the mechanism of geotropism, or the tendency to turn or grow toward the earth, and other kindred phenomena, amplified and further illustrated these conclusions. His curious investigation into heteromorphosis—substitution of one organ by another, transformation of one organ into another—was really an outgrowth of these studies. The importance of the results of the whole series is illustrated in a recent article by Dr. Loeb upon egg structure and the heredity of instincts. Recognition that much of what has heretofore been considered psychical in instinct is merely the necessary result of chemical actions and the mechanical operations produced by them, given external combinations of conditions being present, greatly simplifies the conception of egg structure, and relieves us of some of the embarrassingly complicated conceptions in certain of Weismann's later theories.

The Botanical Laboratory, under Prof. Coulter's direct supervision, is the fourth of this striking cluster of buildings. The most notable feature is the greenhouse in the roof. From below it appears small, but it probably measures something like seventy by thirty feet. It serves two excellent ends: (*a*) it supplies material at every stage of growth for laboratory use; (*b*) it furnishes all kinds of conditions for experimentation. The arrangements for control in temperature and moisture are nearly perfect.

Tropical conditions are presented at the center; desert, arctic, and aquatic conditions are arranged for at other parts. Experiments are to be conducted to determine the effect of varying conditions upon organs. One of the principal subjects hitherto pursued in the field has been the determination of effects of varying environment. This field study is fundamental to, and directly suggests, the experimental work to be followed in the greenhouse. The building is supplied with an elevator which runs to the greenhouse, so that material may be taken down with a minimum of trouble to any floor where it is needed for laboratory work or class-room illustration. The upper floor of the laboratory is devoted to plant physiology. The professor has a suite of three private rooms—one his own office, one a herbarium and library, and one a laboratory. Similar suites of rooms are at the disposal of each of the teaching force. The largest laboratory on this floor is for general elementary work upon individual life processes. Smaller laboratory and research rooms for special and advanced students are numerous throughout the building. Everywhere the work tables are set near windows, and each is supplied independently with gas and water. The chemical laboratory, also on the upper floor, is admirably arranged. On the third floor the study of cryptogamic botany is pursued. The forms are studied (*a*) morphologically, (*b*) taxonomically. The space is divided between two instructors, one devoting himself to algæ and fungi, the other to mosses and ferns. Each of these teachers has the usual suite of rooms, while there are six absolutely independent private research rooms. The second floor is occupied by Dr. Coulter himself. Here is the seed-plant herbarium. There are three large rooms for herbarium or taxonomic work, also the library and reading room, club meeting room, and laboratory for advanced work upon seed plants. Upon the ground floor are two large laboratories crowded with students at elementary work. Their purposes are (*a*) elementary morphology, (*b*) ecology. In the present unsettled condition of the building those parts actually in use are overcrowded. One hundred and five students are daily at work in the various laboratories and research rooms. The Botanical Herbarium represents almost the whole collection work of Dr. Coulter. It contains all his monographic material and the type specimens of his Western flora. It was stocked up by Dr. Gray for the work on the Rocky Mountain flora, and is notably full and rich. The library presents two features of importance in research work: (1) remarkable richness in complete series of periodical and serial publications; (2) unusual fullness in the line of old taxonomic works. Most of these came to the university in the Calvary purchase. In the early days of the university it purchased a gigantic stock of books from a well-known

German second-hand dealer. In this vast mountain of printed matter a number of lines were particularly richly represented; among them was taxonomic botany, a surprising number of rare books turning up which Prof. Coulter had been watching for through years without succeeding in finding. In 1875, at Hanover College, the Botanical Gazette first saw light, and it has enjoyed continuous existence up to the present, always under Dr. Coulter's editorial supervision. At first a personal enterprise, it was taken over by the university in March, 1896. It is a monthly journal, the numbers comprising from eighty to one hundred and twenty pages, and has always been a favorite medium for the exchange of botanical ideas and for the publication of important papers. Notwithstanding the extensive arrangements for the study of botany made at the University of Chicago, Dr. Coulter writes: "But when all the space is used as planned, the demands for work in plant diseases, so extensively cultivated by the Government and at experiment stations; in economic botany, including the great field of forestry; in paleobotany, which is in sad need of being cultivated in a botanical atmosphere, are not met. It will be seen, therefore, that abundant as the space and the privileges are from a comparative standpoint, from the standpoint of the subject in relation to a great university the necessities are far greater."

While the work of the Departments of Sociology, Philology, and Philosophy perhaps deserves mention here, our aim is rather to present those lines of science which by instrumental equipment, museum collections, or rigidly scientific methods of instruction occur immediately to the mind upon the mention of the word science. It is hardly possible, however, for us to omit reference to the University School. Closely connected with the Department of Philosophy and under the same direction is the Department of Pedagogy. The work is both theory and method. To illustrate principles and to furnish opportunity for scientific study of a well-balanced curriculum in the earlier grades, a school is conducted. Something over thirty pupils are in attendance. Prof. Dewey's own statement regarding this school may well be quoted:

"The conception underlying the school is that of a laboratory; it bears the same relation to work in pedagogy that a laboratory bears to biology, physics, or chemistry. Like any such laboratory, it has two main purposes: (1) to exhibit, test, verify, and criticise theoretical statements and principles; (2) to add to the sum of facts and principles in its special line.

"As it is not the primary function of a laboratory to devise ways and means that can at once be put to practical use, so it is not the primary purpose of this school to devise methods with reference to their direct application in the graded school system.

It is the function of some schools to provide better teachers according to present standards; it is the function of others to create new standards and ideals, and thus to lead to a gradual change in conditions. If it is advisable to have smaller classes, more teachers, and a different working hypothesis than is at present the case in the public schools, there should be some institution to show this. This the school in question hopes to do, and, while it does not aim to be impractical, it does not aim primarily to be of such a character as to be immediately capable of translation into the public school.

"The hypothesis underlying this experiment is that of the school as a social institution. Education outside the school proceeds almost wholly through participation in the social or community life of the groups of which one is a member.

"The work here outlined is based on the assumption that the more formal education of the school does not depart from the same general course that the unconscious adjustment follows, but organizes it. The school is a special social community in which the too complex social environment is reduced and simplified; in which certain ideas and facts concerning this simplified social life are communicated to the child; in which, also, the child is called upon to undertake not all kinds of activity, but those specially selected on the ground of peculiar adaptation to the child."

The Haskell Oriental Museum is a three-story and basement building erected by Mrs. Caroline E. Haskell to the memory of her husband, Mr. Frederick Haskell. At the present time the second floor only is devoted to museum collections, but in the near future the whole space of the building will be so occupied. While the most extensive collections are in Egyptology, there are other series. A biblical collection has been begun; the Assyrian collection consists almost wholly of reproductions; the Buckley collection, illustrating the religions of Japan—Shinto and Buddhism—was secured by Dr. Edmund Buckley during a long residence in the Island Empire. This last deserves more than passing notice; while rich on the Buddhistic side, it is notable in Shinto. Shinto is a religion of a barbaric people held by a nation in full civilization; it is profoundly curious and interesting. There is probably nowhere so complete an exhibition of this native Japanese cult as in Dr. Buckley's collection, containing as it does sacred objects, votive offerings, scriptures, prayers, and cult implements. Dr. James H. Breasted is in charge of the work in Egyptology and brings to it an unusual enthusiasm. Recently the Chicago Society of Egyptian Research has been established, with a threefold object: (1) to assist in Egyptian excavation, (2) to bring to Chicago a just share of antiquities so discovered, and (3) to inform its members concerning the ancient civilization which

these discoveries represent. The society was organized March 13, 1897, and is the outgrowth of two movements—the interest shown for some years by Mrs. Charles L. Hutchinson in securing subscriptions to the Egyptian Exploration Fund, and the later interest shown in the same by the Woman's Club. The society raises a considerable sum yearly, one half of which is given to the Exploration Fund, and the balance to the Egyptian Research Account, both of which are practically under Mr. W. Flinders Petrie's direction. Mr. Petrie has sent a considerable quantity of valuable, recently discovered material to the university, which, with the material already secured by Dr. Breasted, forms the Egyptian collection of the Haskell Museum. It comprises a rep-

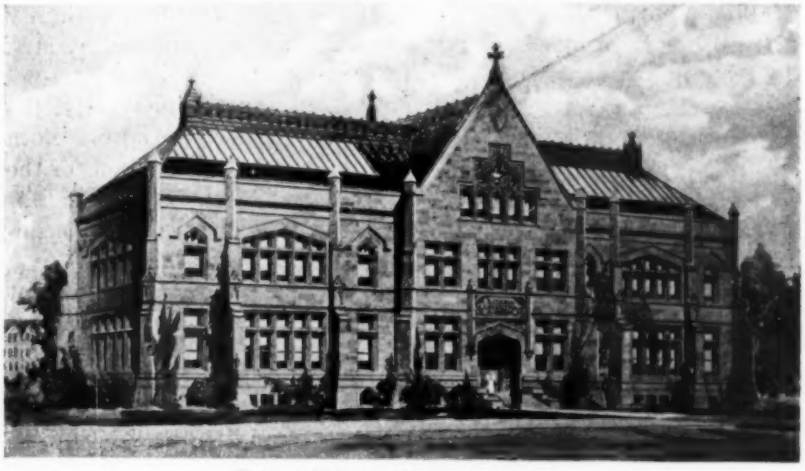

FIG. 9.—HASKELL ORIENTAL MUSEUM.

resentative series of pottery and household utensils, chess board and men, matrices or molds for ornaments and charms, talismans, gods, rings, pendants, etc. A full series of the pottery of the remarkable people discovered by Mr. Petrie opposite Koptos in the winter of 1894–'95 has been sent by that explorer. Among recent additions of interest from the same investigator are many of value because bearing royal names; thus, a sandstone tablet shows Thothmes IV worshiping Amon, with a line of inscription commemorating his overthrow of the barbarians. Several sun-dried bricks are stamped with royal names, and a fine series of jar tops are signed and sealed. Some pieces of gold foil also bear signatures. There is some good carved work in stone, among other pieces a magnificent bust of the goddess Sekhmet. Of wooden tablets, two bearing scenes representing the deceased before Osiris were exquisitely done. In the last shipment received was a fine lot from the old empire representing the fifth

dynasty; limestone portrait statues with the original colors still visible and bearing inscriptions; coffin and mummy of the lady, Mery; an inscribed wooden head rest; and a unique painted board with figures of servants cooking for the deceased. This work of collection so well begun will be prosecuted vigorously, and in time the university will possess a notable Egyptian museum. In one sense the Haskell Oriental Museum is the outgrowth of the Department of Comparative Religion, which is under the direction of Prof. George S. Goodspeed. Courses are offered by Prof. Goodspeed and his helpers in a considerable range. The religions of China, Japan, India, ancient Persia, Greece, Rome, and northern Europe are studied historically and in the light of modern science. A unique feature connected with this department is the establishment of two lectureships on the Relations of Christianity to the other Religions. These lectureships were endowed by Mrs. Haskell, and are known as the Haskell Lectures and the Barrows Lectures. The former are given yearly at the university, the latter are delivered in alternate years in cities of India. Both lectureships are held by Rev. John H. Barrows, President of the World's Parliament of Religions in 1893. The first course of Barrows Lectures was given last year in India, and created a considerable stir.

Presented last, from the fact that much of the work is done at other places than the university proper, is the Department of Astronomy. A small observatory on the campus supplies opportunity for elementary work in practical astronomy by undergraduate students. The Kenwood Observatory, situated in the city about one mile north from the campus, furnishes facilities for practical work by more advanced students in physical astronomy, practical astronomy, and astrophysics. Its astrophysical equipment is complete. The Yerkes Observatory is just being completed, and will soon be in operation. This, the gift of Charles T. Yerkes, is located about seventy miles from Chicago, at Williams Bay, Lake Geneva, Wisconsin. The site occupied comprises about fifty acres of timbered land. The buildings are located upon a gently sloping hill about two hundred feet above the level of the lake and twelve hundred feet above the sea. The place has been especially selected for freedom from dust and tremors. The building is T-shaped, the great dome being at the foot of the letter and the smaller domes at the other extremities, the latter being for sixteen-inch and twelve-inch telescopes. The greatest length of the building, which is from east to west, is three hundred feet. The central body contains library and lecture rooms, laboratories for physical, chemical, and photographic work, computing rooms, and offices. The building is of the best construction. The great telescope is the largest refracting tele-

scope ever constructed, having a forty-inch objective made by Alvan Clark & Sons. The focal length of the instrument is sixty-four feet. The mounting is similar to that of the great Lick telescope, but is heavier, more rigid, and improved. One important advantage introduced for the first time in this mounting is the system of electric motors, by means of which the various motions are effected. By simply touching buttons upon a little keyboard the astronomer may produce any one of ten different results, changing the position of the instrument or of parts of the observatory itself. In this simple way the great instrument may

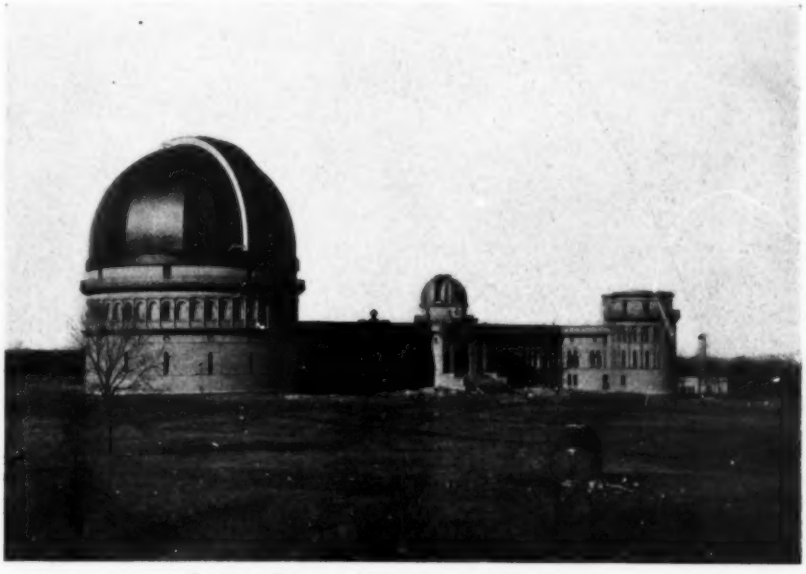

FIG. 10.—YERKES OBSERVATORY, LAKE GENEVA.

be moved, the clock may be started or stopped, the shutter of the dome may be opened or closed, the dome itself may be revolved, or the floor may be made to rise and fall. The dome covering the telescope is about ninety feet in diameter, with an observing slit twelve feet wide extending from the horizon to beyond the zenith. Two spectroscopic attachments are connected with the great telescope: (*a*) a *spectroheliograph* for photographing the solar chromosphere, prominences, and faculæ by monochromatic light combined with a large solar spectroscope for photographic and visual study of solar phenomena; (*b*) a *stellar spectroscope* for photographic and visual investigation of stellar spectra, and determination of motion in the line of sight. The world has a right to expect results from such an instrumental equipment, and the Department of Astronomy has in view important researches. Among these are micrometrical measurement of double stars and

faint nebulæ; observation of planets, satellites, and comets; photographic and spectroscopic investigation of conditions of the sun; researches on the spectra of fixed stars and nebulæ; motion of stars in the line of sight. The Yerkes Observatory will, of course, be used only by advanced students capable of undertak-

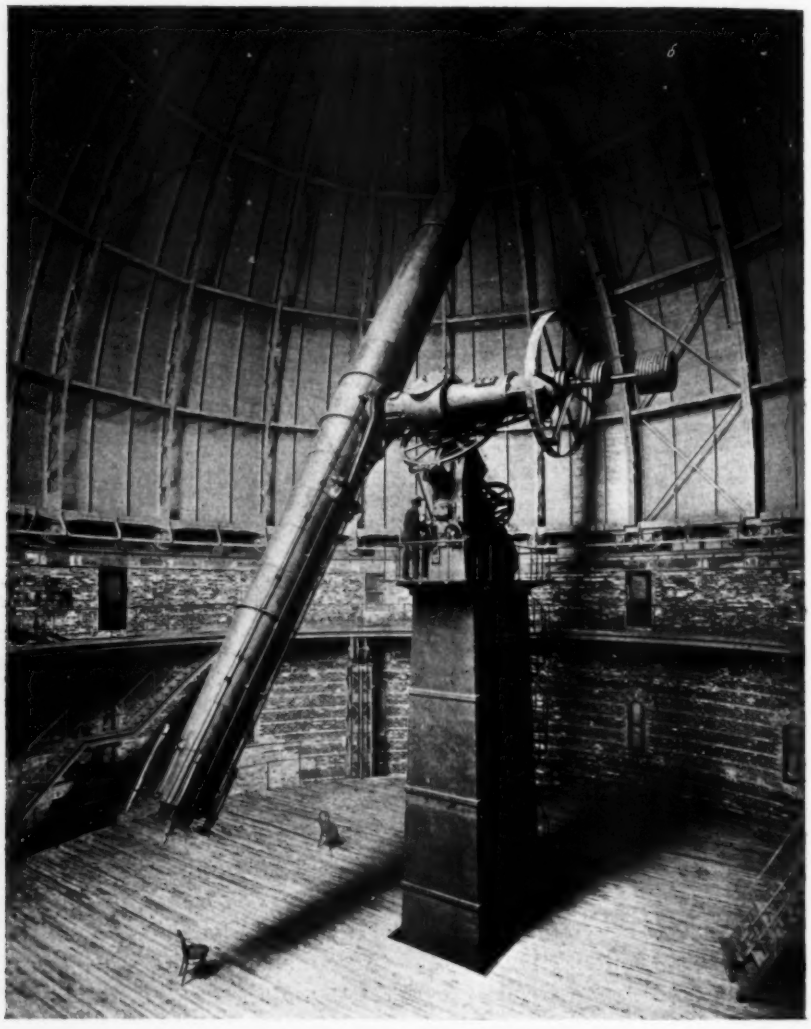

FIG. 11.—THE TELESCOPE, YERKES OBSERVATORY.

ing important and original investigation. The ordinary instruction for undergraduates and elementary students will continue to be given in the city at the university itself and at Kenwood Observatory. It would be a mistake to imagine that up to the present time the university has made no contribution to astronomical science. Important studies have been conducted by Prof. Hale,

Prof. Burnham, and Dr. See; and a journal of high value, the Astrophysical Journal is published through the University Press, under the editorship of Prof. George E. Hale, of the University of Chicago, and Prof. James E. Keeler, of the Allegheny Observatory. In its pages will be found many valuable observations and investigations conducted by the university force.

THE IDEA OF MURDER AMONG MEN AND ANIMALS.

By GUGLIELMO FERRERO.

WHOEVER has studied in its particulars the history of the past knows well that human ferocity is an unfathomable abyss. Who could enumerate all the means invented by men to exterminate each other in turn, from the spear and the yataghan to shrapnel, from hemlock to prussic acid, from Greek fire to dynamite? Were we to try and calculate, even roughly, the number of human beings who have died a violent death at the hands of their own kind, even during that period alone which has elapsed since the dawn of history, the total reached would be undoubtedly monstrous. Nor must we be blinded as to the feelings of our ancestors by the growth of a certain gentleness of manners which has for scarcely a century past been refining human society in Europe; one of our ancestors' chief amusements consisted in the destruction of other men—the extermination of other human beings. Homicide has been at all times, in all forms, and under all conditions, individual and collective, a fierce passion of the human race, a most common incident of everyday life, inspiring no one with any feeling of horror whatsoever. It is sufficient to recall the fact that among people who reached a noteworthy stage of civilization, such as the Romans, war, which is a systematic homicide, or, in other words, ferocity reduced to a science, could be regarded as a financial speculation and a perfectly legitimate one for the educated classes to engage in; and that what is called history is little more than an interminable series of murders, individual and collective, one more ferocious than the other.

The present age has witnessed so important an amelioration of habits that we are apt to forget that it is of very recent date, and to see in the ferocity displayed by our ancestors something contrary to human nature—so much so that we have come to stigmatize all actions of an excessively savage character as "inhuman" and "brutal." A closer analysis will, however, show that this is an illusion; inasmuch as murderous ferocity, by which I mean the passion for destroying life, would seem to be a characteristic

peculiar to humanity, one which either does not exist in animals or has been observed to exist among them only in an infinitesimal degree.

This is one of the most obscure and difficult problems which we meet with in animal psychology. A large number of animals live, it is true, in a state of permanent warfare, killing and devouring each other in turns, but how far does this fact imply another—viz., that this internecine slaughter presupposes in animals a clear idea of death—of the extinction of life as the necessary consequence of their actions? How far are these acts of hostility determined by the intention of depriving another animal of life? In other words, have animals a distinct idea of life and death and of the means by which life may be destroyed?

Let us examine the animals which are considered to be the most ferocious among the mammals—viz., the feline tribe. It is well known that the lion, which attacks another animal in order to make a meal of him, almost always kills his prey by seizing it by the neck and crushing between his teeth the other's cervical vertebræ. Further, the lion's action in this maneuver is so certain that he generally kills the animal at the first attempt. Are we justified in inferring from this fact that the lion has a clear idea of life and death, and that he crunches between his teeth his adversary's vertebræ with the distinct idea of killing him, aware that by so doing he is depriving him of life? I do not think so. When he treats his prey thus he probably merely remembers from former experience that the animal will offer no further resistance and may therefore be devoured in peace—a far simpler idea than those complex differentiated notions implied in a perception of the difference between life and death.

That, as a matter of fact, the lion does not possess the aforesaid idea of life as distinguished from death, and of the possibility of inflicting the latter, may be seen from his behavior when he springs upon a hunter who has wounded him—not to devour the hunter but in self-defense. If he had a distinct idea of life and death and of the means at his disposal of inflicting death, this is surely the occasion in which he should display it. On the contrary, however, it usually happens that when a lion springs upon a hunter that has wounded him and knocks him down, he bites him two or three times, wherever he can; and, having thus satisfied his rage, he goes away, taking no further heed of his enemy, whose ultimate fate depends upon what part of the body the lion has bitten him. If the bite has injured some vital organ, the unfortunate hunter succumbs to his injuries; but if it has been inflicted upon some secondary organ only, he may escape from a most critical position with comparatively little damage. Hence, although the lion's claws are as keen as razors and his

teeth little better than daggers of the most terrible kind, hundreds do frequently escape from conflict with a lion, sometimes almost unwounded. Meunier, one of the most illustrious French observers of animal psychology, narrates how a certain man named Botta was once knocked down by a lion, kept in a perilous position for some time, bruised all over, and badly bitten in the arm, after which the lion went away, leaving the man very seriously but not dangerously wounded. Delagorgue cites a lion hunter who found himself in the same predicament twice within seven years after having fired at a lion. The first time the lion contented himself with fracturing both the hunter's arms; the second time it inflicted six bites and clawed him in several parts of the body, and on neither occasion did it proceed to further reprisals. Another man, Vermaes by name, a farmer living near the source of the Mooi, a tributary of the Tanguela, in Natal, one evening espied a lioness assailing his cattle. Directly he saw her he fired and hit her; but the animal sprang upon him and knocked him down. The man afterward described how he had felt: his ears stunned by the animal's hoarse roars, how he had seen two jaws armed with long white teeth opened wide above him; how he had felt the two sides of his chest being crunched together all the way down; after that, nothing more. He was picked up bleeding from this one bite, after giving which the lioness had departed.

These facts seem to show that the lion is not consciously aware of his power of destroying the life of another living creature. He springs upon his enemy in order to wreak his anger, and bites instinctively, but not to kill him. Hence he bites at random wherever chance offers, without allowing himself to be guided by previous experience, which would have shown him that certain bites given in a certain way may cause death; and as soon as he has satisfied the need he feels of relieving his rage by biting he goes away.

The lion, then, is a dangerous beast, not because he is ferocious in the sense that he enjoys the sensation of successful slaughter—he has not reached the idea of death, and hence can not realize his vast power to inflict it; he is ferocious because he bites when infuriated, and because the bites of an animal so powerfully endowed by Nature are of terrible consequence. Hence it follows that when he strikes his prey so definitely on the neck before devouring it, he does so not with the distinct idea of killing it, but merely because experience has shown him that after having struck it in this particular way he can most easily devour it; and this fact also explains why he does not strike in the same way when he springs upon another creature, not for food, but in a fury of self-defense.

Let us now consider another species of animal, and one nearer to man—viz., the apes, more especially the strongest and most savage of their kind. Here, again, it is permissible to assume that no variety of ape has succeeded in forming a clear idea of death and of the means of inflicting it. Thus, if the gorilla were possessed of the idea of death, and the way in which his formidable arms can cause it, never would man escape from a struggle with such a creature; for, as Brehm points out, a single blow from the huge claw-armed foot of a gorilla can rip up a man, break open his chest, or cleave his skull. And yet many do escape from these encounters with the great simian, maimed and mutilated indeed, but with their lives. Brehm narrates that he has met in Africa with many such horribly mauled survivors. Now, it is evident that if so strong and formidable an animal—whose human foes are absolutely at his mercy, once they have discharged their firearms —frequently fails to kill them, it can only be because he strikes blindly under the influence of rage, without directing his blows in such a way as to indicate that he possesses any consciousness as to the spots in which the blows would produce the most vital effects. The gorilla, therefore, has no idea of death and of the means of inflicting it.

This view is strengthened by all we know concerning the conflicts which take place among the gorillas themselves. The male gorilla fights savagely in the mating season, and yet no one has ever found a dead gorilla which could possibly have perished in one of these skirmishes. On the other hand, gorillas have been seen bearing scars or jagged rents undoubtedly produced by the teeth of some rival in love, an obvious indication that in these conflicts the animals confine themselves to biting as chance directs, and that their frightful capacity for slaughter is not set in motion from any predetermined idea of destroying the life of an adversary.

The orang-outang likewise uses its teeth as sole weapon of offense and defense; and that also on impulse. "When it is wounded or pursued," says Brehm, "it can defend itself well; the hunter should then be on his guard. The animal's arms are strong, and its teeth most formidable; it can easily fracture a man's arm and its bites are horrible."

Let us follow the same author's description of a fight between a dog and a baboon, which is the largest simian after the orang-outang and the gorilla: "The dog follows its foe and endeavors to seize it; but the baboon suddenly turns and springs upon the dog with an appalling howl, grips it with all its claws at once on breast and throat, bites it deeply on those spots several times, rolls with it over and over on the ground, biting again and again, and at last leaves it prostrate, covered with wounds and blood. The baboon then makes for the rocks, uttering yells of

victory absolutely diabolical." Here, too, it is evident that even the strongest baboon is not guided by the idea of destroying its adversary; it is not aware that by compressing the dog's throat it might strangle or suffocate him, that by biting in certain parts of the body it might cause him to bleed to death. It simply allows itself to be carried away by an impulse of fury, which is vented in bites and scratches—sometimes, it is true, of terrific violence—which, however, do not easily cause death, precisely because all these actions, however violent, are not co-ordinated in an end, viz., that of killing the adversary—by a clear idea of death and of the means of inflicting it.

I have cited the above examples to show that in one of the strongest felines and among the strongest and most intelligent of the anthropoid apes the existence of the idea of death and of the means of inflicting it can not be admitted, and that hence the slaughter of one of these animals by another, whether of its own or of another species, can never be the result of a conscious act of volition. In their struggles, both among themselves and with other creatures, their aim is never to kill, but merely to bite and claw; in short, to give vent to their internal rage by violent acts as impulse may direct. And if such acts do sometimes result in death, this fact must be regarded as essentially due to accident, and according as the wound happens to be inflicted, with more or less severity, upon a vital part of the body. But the capacity, predetermined by conscious will, to slay another creature of the same or of a different species seems to be non-existent; and hence all the ferocity of these animals is impulsive, the result of impetus, never a matter of reflection or of will; it is confined between narrow limits, in that it lacks that idea of the possibility of destroying the life of other creatures which has opened such a boundless horizon to the ferocity of the human race.

Can this generalization, which facts demonstrate to be true as regards the lion and some of the primates, be extended to the whole animal creation? To make a similar assertion would undoubtedly be rash; the facts which have been noted are not numerous, and we know little or nothing of the psychology of ferocity even among animals like the tiger, which have, as wild beasts, a terrible reputation, or among others which are extraordinarily intelligent, such as the elephant. Nevertheless I believe that, as we have been able to observe this fact in one of the most feared of carnivora and also among the most intelligent and those nearest to man, we are justified in asserting that the idea of death and the possibility of inflicting it by artificial means in the animal world is at least very indistinct, scarcely dawning, uncertain, and that if any species has arrived at such an idea, it is in such cases a mere dim and blurred outline.

It is therefore probable that the idea of murder is a prerogative of the human race, or that the human race is the only one which has arrived at the conception with great clearness, and that this superiority in man is a characteristic which differentiates him from all the other species of animals. Probably it was in this direction that, at a very early period, in the first beginnings of human life, and in that variety from which *Homo sapiens* emerged by selection, the intellectual force of the human species was directed, and that the comprehension of the difference between the state of life and the state of death, with the perception of the fact that living creatures might be made through certain co-ordinate actions to pass from the first state to the second, was one of the first and grandest discoveries of the human race. It is easy indeed to understand of what great use this discovery was to man in his struggle with animals physically superior to himself, to find himself in possession of the grand secret of life and death. The work of selection accomplished by man among the enemies of his species thus became systematic; it became, notwithstanding the physical feebleness of man's constitution, infinitely more efficacious than the destruction effected by man's foes, who were so much stronger, in the ranks of the human race. Governed and regulated by the clear idea of killing, with deliberate artifice, the enemies of the human race, this selection not only became a terrible weapon and assured victory to man in the struggle for existence, but it impelled him to perfect indefinitely those means of slaughter to which he owed his victory.

This discovery has been of such capital importance that one might say that the idea of killing and being killed is the fundamental idea underlying the mental system of the most savage human races—those that are nearest akin to animals—such as the Australian aborigines, the Botocudos, and the American Indians. It is well known that the savage races suffer from a perfect delirium of persecution, as witness their continual slaughter through some subtle invention of other men. The Australians even have no idea of natural death—can not conceive of a man's dying from any other than a violent cause; they believe that every one who dies has been killed by some hidden agency of destruction, just as he may have laid one low with an arrow. Hence the well-known Australian custom that, on the death of a member of the tribe, a relative must seek out some member of another tribe and kill him to revenge the supposed murder. Superstitions and cruel practices of primitive life, such as we find among the Australians, have their origin in the abuse of generalization from the one primitive discovery that one man has power over the life of another man, and one of the first mental efforts of humanity has lain in connecting these two general extensions of an idea which

is at bottom just, and in connecting it by experience and observation so as to determine its real limits and to prevent man from seeing homicidal forces in every unexplained phenomenon of Nature. This idea was also fraught with importance in regard to forms of social life—an importance so fundamental that a great part of the work of primitive society was nothing but the practical development of this idea. The first form of social progress which we find in the advance of human society is progress in the manufacture of instruments of destruction—spears, daggers, knives, arrows, bows—for among almost all primitive peoples it is in their weapons that we first notice a wide differentiation and variety of shape. There have been many races that had only one form of house, very few articles of clothing or ornament, a single kind of food, or nearly so—none with but one kind of destructive weapon, a single form of knife, spear, bow. The capacity for committing conscious murder upon other beings, of its own or another species, has marked so fundamentally the superiority of the human race over all other species of animals that in the suggestions of this idea there have developed through long time all the mental activities of the human race. This fundamental idea was perhaps the first discovery of man, and ranks with that of fire as among the fundamental discoveries of the history of mankind; and if human cruelty has been only too capable of assuming forms infinitely richer and more varied than the simple cruelty of animals, it is to this discovery that the fact is due.

A DECADE IN FEDERAL RAILWAY REGULATION.

By H. T. NEWCOMB.

IT is ten years since public dissatisfaction with methods of railway administration found legislative expression in the passage of the Interstate Commerce Law, which was practically the first attempt made by Congress to exercise, in relation to railway transportation, its constitutional power to regulate commerce between the several States. Whatever minor causes may have contributed to this dissatisfaction, there can be no doubt that the only subject of disagreement between the railways and the general public which constituted an at all adequate cause was the charges exacted for the movement of passengers and property. While it must be conceded that much of the complaint was unjust to the railways and arose through the fact that, particularly in the more exclusively agrarian sections of the country, much industry was conducted at a loss that might have been shifted to railway corporations could low enough charges for the movement of agri-

cultural products have been secured, it is yet true that numerous individuals and communities had suffered grievous injury through unjust discriminations in the charges for railway service.

Unjust discrimination in railway charges being the evil that Congress intended to eradicate by the Interstate Commerce Law, the extent in which that result has been accomplished during the ten years since its enactment must be the measure of its success. If it has not materially diminished the unjust rate-making practices formerly so prevalent it will be fruitless to plead that it has, through the annual reports of the commission appointed for its enforcement, provided several volumes of most valuable and practical discussions of railway problems; that through a clause which has no direct connection with its substance, and might as well have been an independent enactment, it has given desirable impetus to the application of safety appliances to cars and trains; or even that in spite of limitations voluntarily imposed by the commission it has secured the compilation, under the skillful direction of a most accomplished statistician, of a mass of statistical information regarding the business of railway transportation that is of great utility to the student and may become an important factor in securing wise and adequate legislation.

The means that Congress provided for the prevention of unjust discriminations in charges were threefold, viz.:

First, a summary process for hearing and adjudicating complaints and enforcing relief; second, publicity of railway methods and accounts; third, perpetual competition among railways.

Though the tentative character of the law was acknowledged by the most vehement of its partisans, there has been as yet no amendment in any way modifying these fundamental principles. Those that have been passed—adding the penalty of imprisonment to that of a mere fine for violation of its clauses; extending the provisions requiring filing and publicity to rate schedules, in which two or more carriers join; requiring public notice of reductions as well as of advances in charges; and relating to procedure —have been at the direct instance of the commission and were advocated in its reports.

The first remedy lingers a living death in the reports of the Interstate Commerce Commission, and it may yet be resuscitated by suitable legislation, but it was deprived of all practical force, except as a contributor to publicity, when, in the first action brought to secure a decree enforcing an order made by the commission, a Federal court, in a decision that has been followed uniformly ever since, claimed the right to go into the matter at issue between the defendant railway and the complainant before the commission *de novo*, to hear new testimony if offered, to allow the railway to adopt a new line of defense, and to consider

the conclusions of the commission as to law and fact as merely *prima facie* evidence subject to rebuttal.

Publicity was provided for by authorizing the commission to inquire generally into the business of all carriers subject to its jurisdiction; to keep continually informed regarding their business methods, by requiring annual statistical reports; authorizing the commission to prescribe a uniform system of accounts; requiring the publication and filing of schedules of rates on all traffic subject to the provisions of the law; requiring railways to file copies of agreements with other common carriers; and giving the commission authority to issue subpœnas and subpœnas *duces tecum*. Competition was to be perpetuated by the prohibition of pooling agreements. This and the second remedy have been enforced with reasonable continuity.

Charges for railway service may unjustly discriminate in three ways:

1. When differences are based upon the individuals for whom services are performed.

2. When charges upon different commodities are adjusted for the purpose or so as in effect to foster the movement of one at the expense of the other in a degree not warranted by differences appertaining to the commodities themselves.

3. When charges to or from particular localities favor some to the disadvantage of others more than is justified by natural conditions.

Unjust discriminations between individuals are those most readily observed, and consequently most obnoxious to the general public, though it is doubtful whether their consequences approximate in gravity the serious and deplorable effects of those that fall in the second and third classes. They are effected by means of secret deviations from the published rate schedules, while those between producers of different commodities or between localities appear boldly on the face of tariffs and classifications. The secret rates, rebates, drawbacks, allowances, or other illegal devices resorted to in order to accomplish the first class of discriminations are punishable by fine or imprisonment. The only remedies for the other kinds are modification of the rate schedules or monetary recompense for the damage suffered. The number of discriminations between individuals has been materially reduced by the operation of the present law, but that they have by no means disappeared is evident from the following extract, which, as it is taken from a recent issue of a railway paper of high standing, may be regarded as *ex cathedra*:

"At present no railway man dares to assist the commission to information against another road, no company dares to be the active instrument in bringing complaint against another. It has

its own record behind it. There would be retaliation, and there is no great company which can face having its record of the past years subjected to investigation."

These discriminations are very effective in competition for traffic and will continue an important factor in the railway situation as long as competition is a controlling element in rate-making. It is not even certain that they are not more harmful at present than when more common, and it may be that their baneful effects are accentuated now that, instead of being granted to nearly every applicant, concessions from established charges are accorded only to powerful traders who are able to control traffic sufficient in quantity to yield revenue of almost vital importance to the carrying companies. One of the ablest men ever appointed to be an Interstate Commerce Commissioner has publicly declared that—

"If we could unearth the secrets of these modern trusts, whose surprising exploits excite such wide apprehensions, we should find an explanation of their menacing growth in the systematic methods by which they have evaded the burden of transportation. The reduced charges which they have obtained, sometimes by favoritism and oftener by force, account in great measure for the colossal gains which they have accumulated."

And he adds:

"Indeed, I think it scarcely too much to say that no alliance of capital, no aggregation of productive forces, would prove of real or at least of permanent disadvantage if rigidly subjected to just and impartial charges for public transportation."

Unjust discriminations prejudicial to particular commodities have not been materially reduced in number by the operation of the Interstate Commerce Law. They appear, as has been said, in rate classifications and rate schedules, and the burden of proof is usually upon those who allege that they are unjust. The commission, in response to complaints brought before it, has found it necessary to prescribe the proper relations between rates for carrying the following pairs of commodities: Common soap and pearline, dried fruits and raisins, lumber and hub blocks, lumber and railway ties, wheat and flour, corn and its products, grain and grain products, celery and green vegetables, window shades and hollands, and petroleum and its products. These, however, involve but the smaller side of the question. It is not clear that rates as at present adjusted are relatively reasonable as between, for example, the products of agriculture and those of other industries, nor that they do not bear with undue relative severity either upon the grain producer of the trans-Mississippi region or the cotton planter of the Gulf States. These are matters with which the Interstate Commerce Law does not effectively deal, and which

can not be so dealt with until the law is modified in a manner more radical than any yet officially suggested.

The most serious class of unjust discriminations includes those which have for their victims the entire populations of towns, cities, and even extensive districts which are made to suffer from the unfair adjustment of railway rates. Practically the whole region south of the Potomac and Ohio and east of the Mississippi has continuously suffered from discriminations of this kind through the system of making charges to a few selected cities the basis for through rates to all other points. Through rates are made to and from about two hundred of the larger towns, including Atlanta, Birmingham, Chattanooga, Vicksburg, New Orleans, and Mobile, and traffic shipped from or to all other points is charged the rate to one of these basing points plus the local rate from such basing point to final destination. In practice it is common to make the combination by the use of rates to and beyond whatever basing point will give the lowest total, whether on the line traversed by the shipment or not. Thus a shipment from Cincinnati to a point on the line from that city to New Orleans may be charged the full rate to New Orleans plus that from the latter back to the local point. The condemnation of such a system can not be too severe. It not only limits the commercial activities of the towns unjustly discriminated against and restricts the sources from which they can directly draw supplies, but by hindering their growth it retards the development of the entire section, including the cities supposed to be favored.

The manner in which competition at points served by two or more railways affects those having but one has received general recognition, and is one of the most powerful causes of the too rapid construction that has burdened the country with many unnecessary, unprofitable, and bankrupt lines. To attempt to regulate these cases by the process of taking them up singly and prescribing the alterations necessary to make the charges relatively reasonable, is a task impossible on account of magnitude. Though the relief afforded to particular places through the orders of the Interstate Commerce Commission has often been of great local importance, a large number of its decrees, including those most important, have been entirely ignored, or are now awaiting enforcement through the tedious processes of the courts. Even had the commission itself the authority of a United States court, and were there no appeal from its decisions, the town with two railways would still have an immense advantage over that with one.

In the case of the Eau Claire Board of Trade, decided by the Commission in 1892, it was contended that the rates charged on lumber from Eau Claire to points on the Missouri River were so

high relatively to those from points competing for the business of supplying the same markets, as practically to destroy the business of Eau Claire. Only a few of the roads serving these competing points reached Eau Claire, and accordingly the only practical mode of adjustment, from the standpoint of the law, was to order a reduction from that point. This the commission did, but added:

"Undoubtedly those roads" (referring to those not serving Eau Claire, and consequently not included in the order) "have it in their power to continue the present disparity, but we do not anticipate, and certainly can not assume, that they will resort to such inconsiderate and arbitrary action in order to nullify the lawful order of this commission."

The compliance of the defendant railway with the order of the commission was, however, almost immediately nullified by the action upon the part of the other railways which that body had most properly refused to anticipate, and the rates of all lines were ultimately restored to practically the figures in effect previous to the complaint.

The conditions described are fairly typical of those existing all over the United States. The Interstate Commerce Law has mitigated but slightly, if at all, the evil of unjust discrimination between individuals, has in but few and relatively insignificant instances moderated unjust discriminations between articles or classes of traffic, and has almost wholly failed to remedy the far more serious inequities in rate-making which operate to the disadvantage of towns, cities, or districts.

If it were true that the single step necessary to prevent or alleviate considerably the evils described is to re-enforce the law by adopting the amendments suggested by the commission, or otherwise to perfect the remedies already provided, adequate and early relief might reasonably be hoped for. That the commission does not take this complacent and superficial view is evident from the following extract from its Ninth Annual Report:

"Those who have given most reflection to the subject of government regulation are aware that the laws now in force are more or less tentative and experimental, and such persons anticipate that the evolution of railway control by public agencies will sooner or later result in a more comprehensive and direct exercise of the power possessed by Congress to regulate our internal commerce."

In fact, while the commission is, to adopt its own phrase, asking Congress merely "to make the act mean what it was supposed to mean at the time of its passage," it must be itself aware that it then contained the cause of endless discriminations. Says Commissioner Knapp:

"The power to compete is the power to discriminate, and it is simply out of the question to have at once the absence of discrimination and the presence of competition."

And he adds:

"I regard the existing law as presenting this singular anomaly, that it seeks to enforce competition by the mandate of the statute, and at the same time to punish as criminal misdemeanors the acts and inducements by which competition is originally effected."

The unreasonable rate not made either to secure competitive traffic or to recoup losses from carrying such traffic at too low rates is so extremely rare that its very existence may well be doubted. Unjust discriminations between individuals are resorted to in order to secure by means of secret rates, rebates, or other devices a greater proportion of the traffic from or to competitive points than would be carried at open and equal rates. Discriminations between commodities result most frequently from favoring articles produced by heavy shippers or in towns at which competition is sharp, or from the fact that the railways agreeing to a particular classification have not a sufficient identity of interest to make naturally for harmony and justice. Localities either are favored unduly because they are served by competing lines, or are discriminated against in order that low rates may be maintained at other points more fortunate in this respect. The charges to local points on main and branch lines are too high relatively to those at terminals where there is competition. Yet it can not be denied that so long as the carriers are independent of each other in the matter of revenue there will be many plausible arguments available for the defense of these relations. The difficulty of dealing with such discriminations is greatly enhanced by the insufficient information upon which it is necessary to decide regarding the reasonableness of rates under present conditions. Thus, in determining whether a given rate on wheat from Chicago to New York is reasonable and just, it may be necessary to consider the rates on the same articles to Buffalo, New York, Philadelphia, Baltimore, Boston, Montreal, Newport News, and other Eastern points not only from Chicago, but also from Minneapolis, Duluth, East St. Louis, Peoria, Cincinnati, Buffalo, and other places. Rates on flour, corn, and corn meal between any of those points may also be involved; and possibly the charges on any of the commodities named from St. Paul or St. Louis to New Orleans *via* the Mississippi River boats, and from New Orleans to New York or Liverpool by steamer, may in some way be connected with the controversy so as materially to affect its decision. In fact, it is impossible to set any limit to the data that may have important bearing upon the question at

issue, or to say of any fact concerning commerce or transportation that it would necessarily be wholly irrelevant in such a controversy. Yet the parties defendant, when such a case is heard before the Interstate Commerce Commission or the courts of the United States, are the carriers between Chicago and New York only. When the interdependence of all rates is thoroughly understood and the extent and importance of this condition fully appreciated, it will be a matter of little surprise that through the absence of sufficiently comprehensive information in particular cases, and through the impracticability of treating the subject of railway rates under the present system in the broad and thorough manner absolutely essential to the correction of the evils now existing, even the clear-headed and able men who have constituted the Interstate Commerce Commission have been led into occasional errors which have furnished arguments to those who from self-interest desire a return to the system in vogue when there was no public supervision of interstate commerce by rail.

The conflict of interest between the several corporate units of the railway system is the primary cause of the evils attendant upon railway transportation as now conducted. This fact being clearly established, it is at once evident that that portion of the Interstate Commerce law which was intended to perpetuate competition—i. e., the fifth or antipooling section—is radically antagonistic to any wise and practicable system of railway regulation. It is necessary at the outset, as a first step toward a system under which railway rates can be made equal to all, that this restraint upon the carriers should be removed—not in order to save them from the bankruptcy that is almost certain to follow the vicious methods now in vogue; not for the sake of the thousands whose small savings have been invested in railway securities in the reasonable belief that Congress would not legislate so as to destroy an investment through which private capital is made to perform a public function, but in order to relieve individuals, classes of property, and localities from the unjustly discriminating charges for railway service from which they now suffer. At the same time Congress should give some substantial finality to the findings of the board of railway experts which under the name of the Interstate Commerce Commission it has created to adjudicate between the railways and their patrons, and should strengthen the visitorial functions of that body by granting whatever amendments to the law are necessary in order to secure the production of all the legal testimony desired and by considerably widening the scope of its statistical investigations.

But this is only a beginning of progress toward more enlightened methods of dealing with this important industry. It has never been found profitable to legislate in restraint of natural

economic forces, but the best results have accrued when statesmen have frankly recognized the tendency of those forces and have sought to make their operation useful to society. The force which tends toward the consolidation of railway properties is one of the most powerful, and it is now recognized that such consolidation is in the public interest. All provisions forbidding or hindering the various forms of consolidation of parallel or connecting railways, whether contained in State Constitutions or in Federal or State statutes, should be repealed, and public and legislative encouragement so far as practicable should be generously accorded to every step that tends toward the complete harmonization of the railway system. If this somewhat radical change in the attitude toward the railway monopoly can be effected it will not be long before favoritism will become as rare in railway rates as in the rates of taxation.

EARLY AMERICAN CHEMICAL SOCIETIES.*

By Prof. H. CARRINGTON BOLTON, Ph. D.

THREE chemical societies were organized in the United States before the close of the first quarter of this century: 1. The Chemical Society of Philadelphia, founded in 1792. 2. The Columbian Chemical Society of Philadelphia, founded in 1811. 3. The Delaware Chemical and Geological Society, founded in 1821. These societies were short-lived, local in jurisdiction, and without much influence on the progress of the science; but it is interesting to note that professional, teaching, and amateur chemists in America formed associations for mutual improvement and for the advancement of their calling forty-nine years earlier than their brethren in England. American chemists were not impelled to form independent societies owing to a lack of organizations for men of science, but they early felt the advantages of specialization. Both the society of 1792 and that of 1811 were formed in a city honored by the presence of the venerable and dignified American Philosophical Society, established by Benjamin Franklin in 1743.

1. The Chemical Society of Philadelphia was undoubtedly the earliest organized body of chemists in either hemisphere; it does not appear to have published records of its meetings, but in 1801–'2 it was presided over by Dr. James Woodhouse, the vice-presidents being Felix Pascalis and John Redman. Dr. Wood-

* Abstract of a paper read to the Washington Chemical Society, April 8, 1897.

house (1770–1809) was at the time Professor of Chemistry in the medical department of the University of Pennsylvania, of which he was a graduate. This chair had been held by Dr. James Hutchinson, and on his death, in 1793, Dr. Joseph Priestley, who arrived from England a few months later, was invited to succeed him, but he declined, preferring retirement at Northumberland, and Dr. Woodhouse was chosen instead. He was more of a physician than a chemist, and most of his writings were on medical topics, but he edited Chaptal's Elements of Chemistry and other works. He is said to have been the first to prove by comparative experiments the superiority of anthracite coal from Pennsylvania over bituminous coal from Virginia for intensity and regularity of heating power.

The first vice-president, Felix Pascalis-Ouvrière (1750–1840), had an interesting career. He was born in France, where he received his medical education, but emigrated to Santo Domingo, and while practicing his profession there acquired an extensive knowledge of botany and other branches of natural history. In 1793 a revolt among the negroes compelled Pascalis to take refuge in the United States: he settled first in Philadelphia and afterward in New York, where he aided in founding the Linnæan Society of New York. The second vice-president, Dr. John Redman (1722–1808), was one of the foremost practitioners of medicine in Philadelphia, and from 1786 was President of the Philadelphia College of Physicians.

Among the most active members of the Philadelphia Chemical Society were Priestley, Hare, and Seybert. The ambition of the members is shown by the circumstance that a standing committee in 1802 was prepared to "annalize every mineral production" sent to them, free of expense. The meeting held October 24, 1801, was made memorable by the appointment of a committee for the "discovery of means by which a greater concentration of heat might be obtained for chemical purposes." One of the committee, Robert Hare, then only twenty years of age, reported to the society on December 10th his invention of the "hydrostatic blowpipe." Hare's remarkable paper was printed in a small pamphlet of thirty-four pages with the title, Memoir on the Supply and Application of the Blowpipe, containing an account of a new method of supplying the blowpipe either with common air or oxygen gas. Hare's invention yielded a fruitful harvest of discoveries and alone justified the existence of the first of chemical societies; his subsequent career as Professor of Chemistry in the medical school of the University of Pennsylvania from 1818 to 1847 is well known.

2. The Columbian Chemical Society of Philadelphia was founded in the month of August, 1811, by a "number of persons

desirous of cultivating chemical science and promoting the state of philosophical inquiry."

The principal officers elected at the first meeting were as follows: Patron, Hon. Thomas Jefferson, Esq.; president, Prof. James Cutbush; vice-presidents, George F. Lehman, Franklin Bache.

Thomas Jefferson's commanding position in the world of science and arts, as well as his literary attainments, well qualified him for the office of patron; he was at that time living at his country seat in Virginia, having already served his country for eight years as chief magistrate.

The president of the society, Dr. James Cutbush, was Professor of Natural Philosophy, Chemistry, and Mineralogy at St. John's College; in 1814 he held the position of assistant apothecary general in the army, and he afterward became Professor of Chemistry and Mineralogy at the United States Military Academy, West Point, where he died in 1823. Dr. Cutbush published several books, the best known being A System of Pyrotechny (Philadelphia, 1825), an elaborate work of six hundred pages.

Franklin Bache, the second vice-president, was at that date a youth of only twenty years, who had graduated the year before at the University of Pennsylvania. He was a grandson of Benjamin Franklin and a member of the distinguished Bache family which numbered so many eminent men of science. He afterward became Professor of Chemistry at the Jefferson Medical College, a position which he held until his death in 1864.

The constitution adopted by the founders of the society, besides the usual business rules, contained some unusual features. The officers included an orator, whose duty it was to deliver an oration on some chemical subject once every year. Since the Society's Memoirs contain no "oration," it is to be feared that the incumbent's efforts were not satisfactory. The constitution undertook to control the members' actions by a series of fines: twelve and a half cents for absence each roll, and one dollar for refusing to accept an office or declining to read an original chemical essay when appointed to do so. To insure against members withdrawing early from a dull meeting, the secretary was directed to call the roll at the opening and close of each meeting, and to fine absentees twelve and a half cents. Candidates for membership were required to read an original essay on some chemical subject to be discussed by the members, and a two-thirds vote was required to insure election. It seems to have been easier to be put out of the society than to get into it, for "any member behaving in a disorderly manner shall be expelled by consent of two thirds of the members present."

There were two classes of members: "junior," thirteen in num-

ber, and "honorary," sixty-nine in number, of which thirty-one were Europeans; the home list included most of those chemists whose labors contributed largely to the foundations of the science in the New World. Brief notices of the prominent ones are here given:

Dr. Benjamin Smith Barton (1766–1815), who has been called by his admirers "the father of American natural history," held the chair of medicine, natural history, and botany in the University of Pennsylvania; he was an agreeable writer on natural history topics.

Dr. Archibald Bruce (1777–1818) was one of the pioneers of mineralogical science in America, and published one volume of the American Mineralogical Journal in 1810; he held the chair of mineralogy in Columbia College, New York.

Thomas Cooper (1759–1840), born in London, accompanied his friend Priestley to America in 1793, sharing his radical views in politics and religion. He held the chair of chemistry at the college in Columbia, S. C., of which he afterward became president.

Dr. Edward Cutbush (1772–1843) was surgeon in the United States Navy and Professor of Chemistry in the medical school of the Columbian University from 1825–'27.

Dr. John Griscom and Dr. David Hosack were both citizens of New York; the former had the honor of being regarded as the head of all teachers of chemistry in New York for thirty years; the latter was Professor of Botany and Materia Medica in Columbia College, but is best known as the founder of the first public botanic garden in the United States in 1801. He died under tragic circumstances—of shock at the disastrous conflagration in New York city which swept away his property to the value of $300,000.

Dr. John Maclean (1771–1840) was the first Professor of Chemistry in the College of New Jersey, now Princeton University, to which chair he was elected in 1797.

The Hon. Samuel L. Mitchill, M. D., F. R. S. E. (1764–1831), was not only an active Professor of Chemistry and Natural History in Columbia College, New York, and editor of the New York Medical Repository, but he was Senator of the United States from 1804.

Dr. Benjamin Rush (1745–1813) was undoubtedly the first professor of chemistry in America, his appointment dating August 1, 1769. In his busy life he was Professor of the Institutes and Practice of Medicine in the University of Pennsylvania, besides acting as Surgeon General of the United States Army, Treasurer of the Mint, President of the Society for the Abolition of Slavery, and Vice-President of the Bible Society of Philadelphia, in which city he also conducted a large medical practice.

Dr. Adam Seybert (died 1825) was a pioneer in air analysis, having made twenty-seven analyses of the air by eudiometric methods on a voyage across the Atlantic in 1797. He came to the conclusion that the sea exerted purifying power over the air.

Benjamin Silliman, at the time of the founding of the Columbian Chemical Society, was forty years of age and had held the chair of chemistry in Yale College for ten years. The American Journal of Science was not begun until 1818. Silliman's name is a household word among us, and no eulogium is here needed to magnify his position in the scientific world.

The prominence of medical men on the roll of members is evident and readily explained. Before the days of schools of science, and before colleges devoted a portion of their curricula to scientific studies, almost the only training in science received by American youth was in the medical schools. The chairs of natural history and of the physical sciences were almost exclusively held by physicians whose education more nearly qualified them for teaching these branches of knowledge than the graduates of the classical courses customary in all colleges. To elevate the standard of membership in the Columbian Chemical Society a number of distinguished foreigners were enrolled. These included such men as Berthollet, Gay-Lussac, John Dalton, Sir Humphry Davy, and Dr. Wollaston, but no representatives of Germany or Sweden, which presumably indicates that at this early date communication and exchange of courtesies with Germany and northern Europe were less common than with France and England.

The society issued in 1813 one volume of Memoirs, containing twenty-six essays by ten writers on a great variety of topics—original, speculative, and practical. Eight of these papers are from the pen of Dr. Thomas D. Mitchell. In his Remarks on the Phlogistic and Antiphlogistic Systems of Chemistry he supports the Lavoisierian theory of combustion, stating that there is "no necessity for a principle of inflammability." He cites the experiment of Woodhouse, who obtained an inflammable air by heating charcoal with scales of iron, both being free from water; and points out that Cruikshank, of Woolwich, demonstrated that the inflammable gas thus obtained is gaseous oxide of carbon (carbon monoxide), discovered by Priestley in 1799 and combustible although containing no hydrogen. He compares combustion with neutralization of an acid and base, and says, "Inflammation and acidity are effects resulting from the action of relative causes and not attributable to a single agent or principle."

Dr. Mitchell, in his paper Remarks on Heat, objects to the term "latent heat" and to Dr. Black's theories. In a paper entitled On Muriatic and Oxymuriatic Acids he attacks the views of

Sir Humphry Davy as to the non-existence of oxygen in muriatic acid, clinging to the statement of Lavoisier that all acids contain oxygen, and he claims that combustion is accompanied by decomposition of oxygen gas. The doctor's Analysis of Malachite from Perkioming, Pa., is given as follows: One hundred and twenty grains of the green carbonate contained carbonic acid, thirty grains; quartz and siliceous earth, sixty-eight grains; brown oxide of copper, fifteen grains; loss, seven grains. The specimen was evidently a poor one. No account was taken of the water, and reporting results in percentages does not seem to have been in vogue.

The same writer, in Remarks on Putrefaction, discusses the action of antiseptics and attributes the virtues of nitrate of potash to the increase of cold produced by the muriate of soda. His other papers are argumentative and speculative, with little originality.

Franklin Bache's three papers are likewise speculative disquisitions. In one he points to the "great error" in which Berthollet fell as respects the law of chemical affinity, and in another he proposes to introduce the following improvements in nomenclature: Nitral acid forming nitrotes; nitril acid forming nitrutes; nitrous acid forming nitrites; and nitric acid forming nitrates.

Four of the papers in the Memoirs are by Dr. John Manners. His Experiments and Observations on the Effect of Light on Vegetables abounds in quotations from Darwin's Botanic Garden. In the Mineral Spring at Willow Grove, fourteen miles from Philadelphia, he found iron and sulphureted hydrogen. In Experiments and Observations on Putrefaction he tested the influence of carbonic acid, hydrogen, and other gases on putrefying flesh, and he attempted to collect and analyze the gases generated by the same. He concludes that "putrefaction depends on a destruction of the equilibrium of attractions which exists in the elementary principles of which the animal substance is composed in a healthy state, occasioned by the loss of vitality in consequence of which new compositions and decompositions ensue."

The president of the society, Prof. Cutbush, describes quite clearly the "oxyacetite of iron" as a test for the detection of arsenic, a process since used quantitatively by Kotschoubey.

Speculations on Lime, by Dr. Joel B. Sutherland, contains the singular claim that if mortar be made with sand containing common salt the resultant compound gives "so much coldness to the mass that during the whole summer vapor is almost incessantly precipitated on a wall" with which it is plastered.

Mr. Edward Brux, of France, one of the junior members, writes Upon the Effects of Various Gases upon the Living Animal Body, which consists largely of speculations, notwithstand-

ing which he cites an admirable passage from Dr. Bostock: "Physiologists have in general been more inclined to form hypotheses than to execute experiments, and it has necessarily ensued from this unfortunate propensity that their science has advanced more slowly than perhaps any other department of natural philosophy." Unfortunately, this truth was not fully recognized by the members of the Columbian Chemical Society.

A contemporary journal (New York Medical Repository) reviews the Memoirs in the following quaint style: "It is highly gratifying to behold a band of worthies like those before us laboring to analyze the compounds which they find ready made, to form by synthesis new combinations in the laboratory, and thereby to deduce correct doctrines from the facts which are disclosed. We cordially congratulate them on their noble occupation and on the progress they have made. We hope they will be persevering and undaunted; and if from this beginning there shall arise great improvements in theoretical disquisition, as well as in economical exercise, we shall rejoice with a mingled glow of amicable and patriotic sentiment."

3. The Delaware Chemical and Geological Society was organized at Delhi, Delaware County, New York State, September 6, 1821. The first meeting was held at the hotel of G. H. Edgerton, in the village. The president was Charles A. Foote, and the vice-president the Rev. James P. F. Clark. The society was composed of "between forty and fifty well-informed and respectable inhabitants of the county." It had for its object the improvement of the members in literature and science, especially in mineralogy and chemistry. The members planned to form a library, and they made a collection of the minerals and rocks of the region, but the society was not long sustained.

In reviewing the condition of chemical science in the United States as indicated by the membership and achievements of these early societies, we note that those who held the most prominent places were handicapped by the necessity of devoting a large part of their intellectual energy to topics quite outside of the domain of chemistry itself. The active members were either busy with the art of healing or with teaching several branches of the physical and natural sciences, and too often chemistry was regarded in the colleges as a kind of side issue or appendix to the more important subjects of instruction. This was caused by the necessity of earning a competence at a time when there was no opportunity of reaping pecuniary rewards by skill as an analyst or by the application of science to the manufacture of products involving chemical knowledge. Indeed, in default of this stimulus to laboratory work it is not surprising that the papers read to the societies were largely either reviews of the grand discoveries made by

Europeans or essays in which the imaginative faculty was given free play, it being far easier to indulge in speculations than to discover new facts.

In the early struggles of a country to secure a place among nations few men of ability can devote their energies to the pursuit of science for science's sake. The environment is more favorable to development of the inventive faculty than of the peculiar talent for conducting abstruse researches in an exact science. Add to this the limited facilities for acquiring chemical knowledge in the New World and the distance of amateurs from the European head centers of learning, and it is certainly noteworthy that American chemists combined to form associations for mutual improvement and the advancement of their calling at so early a period.

A fourth attempt to establish a chemical society was made at New York city in 1876. The organization was at first somewhat restricted in its plan, but in 1892 a change in its constitution was effected which broadened its scope, and it now forms a strong, influential, and truly national society. Its nine hundred and eighty-four members, working in nine chartered sections, represent forty-seven States and Territories, besides several countries of Europe, South America, and distant Australia. Its Journal, comprising eleven hundred and fifty pages annually, is an authoritative medium for the preservation and diffusion of the researches made in the United States, and its annual meetings, held in diverse localities, strengthen the bonds which unite its members in good-fellowship and in the pursuit of their common profession.

THE recent publication of Mr. H. W. Seager's book, Natural History in Shakespeare's Time, has incidentally made it evident that our master poet was great in this as in all other fields, and that his allusions to animal life and habits are not based on the fables in which his contemporaries indulged even when writing seriously on the things of Nature, but on his own or other accurate observations. Of such are his allusions to the quick breathing of the captured sparrow, to the fast work underground of the mole, to the wounded duck hiding among the sedges, to the scattering of the wild geese at the firing of the fowler's gun, and his lamentation over the killing of a fly by Marcus. An English reviewer of the book well says that "the truth is that Shakespeare's natural history is modern in its vividness, its good sense, its sympathy. It is more profitable to compare his bird lore with Gilbert White's than with anything in Bartholomew; more just to set his animals against Buffon's than the grotesque 'four-footed beasts' of Topsell; more useful to verify his botany by Sowerby than by Gerarde or John Parkinson. Modern naturalists and Nature-lovers have not been slow to claim Shakespeare as their brother." Yet his characters sometimes bring in the natural-history fables of the time. They would not be true to what he intended to make them appear if they knew better.

THE ECONOMIC VALUE OF ANIMALS.

By CHARLES FREDERICK HOLDER.

THE influence which the lower animals have had upon mankind has never been appreciated; had it been, they would have received more consideration at our hands. They not only provide us with food, raiment, and a vast array of industries, but they have been factors in the physical and intellectual development of mankind. The beauty of the birds and insects, the splendid coloring of the fishes and reptiles, the quiet harmonies of Nature and the problems they suggest, have insensibly had a refining effect, and aided in the evolution of the higher and æsthetic senses. In a word, the so-called lower animals have been important factors in producing the high civilization which marks the Caucasian race of to-day.

In glancing at the many forms which pay tribute to our wants and requirements, the larger animals naturally attract the attention; yet the greatest works, the most enduring monuments, are those produced by the smallest and most insignificant creatures. Such are the rhizopods—minute marine forms almost invisible, among the very lowest in the scale of life; literal drops of jelly, yet endowed by Nature with the power to secrete shells of rare and beautiful shapes. So vast are their numbers that it has been estimated that if they are as numerous down to a depth of six hundred feet as they are near the surface, there are more than sixteen tons of calcareous shells suspended in the uppermost one hundred fathoms of every square mile of the ocean.

These countless millions are constantly dying, and their shells when released slowly sink to the bottom in a never-ending rain, filling up the inequalities of the ocean bed, and forming a deposit of ooze at a depth of not over twenty-four hundred fathoms several feet in thickness, beneath which are layers of shells of an unknown depth pressed into a solid mass. A prolific source of this ocean rain is a rich spiked atom which has given its name to the globigerina ooze that is almost universal in the deep sea at a depth within the limitations given.

The tendency of the rain of shells is to fill up ocean beds, cap submarine hills and mountains, building them up until they enter the zone of the reef-building corals. In this way these insignificant creatures have aided in the growth of the globe, and, when the deposits by heat or exposure to air are hardened, they become girders of the crust.

The ooze so deposited either fills up the ocean, or by some upheaval is lifted into the air and in time becomes covered with a forest growth; ages pass, and, by a depression of the crust, the

hardened ooze again becomes the bottom of an ocean, subject to another rain of shells; and so the change goes on, and we may trace the rhizopods back to the Archæan time, millions of years ago, their story being told by the limestone deposits alternating between the metamorphic schists of that ancient period—monuments of the part these insignificant creatures have taken in preparing the world for man. The chalk cliffs of England are among the visible evidences of this work, the chalk being formed of rhizopods once deposited at the bottom of a sea, but now reared high above the surface to tell the marvelous story. The city of Paris is built of stone formed by rhizopods and other forms, and the pyramids of Egypt are constructed of the remains of various species of fossil animals; yet how these magnificent works of man pale into insignificance before the unconscious work of these minute animals!

Very near the rhizopods are the sponges; lowly creatures whose skeletons are of great value—their collection and preparation forming a vast industry in many parts of the world; a step higher in life we find the coral polyp, secreting lime and piling up reefs and islands that are important girders of the globe. I have spent days in following a coral reef in the Helderberg Mountains of New York far from the reefs of to-day; and we find evidences of them everywhere in the rocks of early geological times. The great reef of Australia, the populous coral keys of the equatorial Pacific, the State of Florida, a reef of seventy-eight thousand square miles in extent, illustrate the value of this polyp to man.

All these animals have other values. From the rhizopod cliffs of Dover comes chalk, while heat is supposed to have changed the skeletons of sponges into flint, so valuable in many ways. Heat has transposed the old coral reefs into beds of marble; and we have the Capitol at Washington, and all the noble works of art of the old Roman and Grecian masters, carved from the crystallized remains of these lowly creatures.

The shells of the seashore and river all have a direct value; the oyster industry of New York city alone represents a capital invested of over two million dollars, which means the support of thousands of men, women, and children. Even the discarded shells constitute an important branch of trade in themselves. Germany and England use tons of pearl oysters, sending them to us in the form of buttons, cheap ornaments, and other articles. The pearl fisheries of the Persian Gulf pay one million dollars per annum; of Australia, three hundred and eighty thousand dollars; while those of Lower California have produced some of the finest and most valuable pearls during the past two centuries. The collection of abalone shells in the State of California means an income of over fifty thousand dollars to the parties interested,

while the sale of the polished shells as curiosities gives employment to many persons. From the whelks a dye is obtained; sepia comes from the cuttlefish or squid; while one species provides the cuttlefish bone of commerce. The smallest worm, which Shakespeare tells us, "will turn, being trodden on," has its place in the economy of life. The phosphorescent worms add to the splendors of the festivals of the nights along our shores, and are among the illuminators of the ocean; as bait they have a relation to the fisheries; leeches have a medicinal value, while the common earthworm is a valuable ally of the farmer. Darwin estimates that there are one hundred thousand earthworms in the upper six feet of every acre of ground in favorable localities, and in New Zealand three hundred thousand. They are continually turning over the soil, dragging down seeds and leaves, and bringing to the surface in some places ten tons of mold to the acre every year, thus performing a valuable service to the agriculturist.

The crustaceans are among the important scavengers of the sea and are also valuable as food for fishes. The collection of crabs, shrimps, and lobsters forms large industries all over the world, contributing directly to the support of man. In Delaware the horseshoe crab is used as guano, while the collection of fossil crabs, as trilobites, is a peculiar industry. The fresh-water crayfish produces a concretion used as an antacid, well known to chemists. We owe many of the beauties of our summer fields to insects, all of which have their special functions and use. Even the persecuted flea may render man a service by keeping the drowsy watch dog awake, while the mosquito in tropical countries may aid in preventing the human inhabitants from living a continual *siesta*.

The flies are among the most valuable insect scavengers. The spiders prey upon flies, holding them in check. The silk of the spider is used as a cross line in astronomical instruments, and that of a Bermuda species as sewing silk. Bridge makers have obtained valuable suggestions from these silent workers, from whose web one of the kings of France is said to have made a coat. Grasshoppers and locusts are enemies of civilized man, but are eaten by the Indians, while in the Malay country the dragon fly is considered a delicacy.

The cochineal produces the famous commercial dye, a valuable industry. Manna comes from the puncture of an allied insect, while another insect produces wax. A popular eye powder among the Chinese is made from a fly. The silk industry in the United States, the product of the silkworm, represents a capital of twenty-seven million dollars, and the moths and butterflies perform an equally valuable work in fertilizing flowers, thus insuring the crops. A decoction of oak and other galls of the gall

fly is an important ingredient in certain inks. Ants are valuable scavengers, and some produce an acid used in trade. The remarkable honey ants of the Southwest are considered dainties in Mexico and served after dinner alive. In the nests of these ants certain individuals cling to the ceiling, their abdomens filled with honey, which has been given to them by their companions, so they are literally living honey jars, holding the reserve food supply of the others, which they give up on application. The distended abdomen, about as large as a currant, is the luxury of the Mexicans.

Bees have a sterling value the world over and support many men, women, and children. A few years ago a single bee ranch in San Diego County, California, produced one hundred and fifty thousand pounds of honey and wax. The importance of bees, aside from the question of honey, is shown by the fact that it was found impossible to cultivate red clover in New Zealand, as there were no bumblebees to carry the pollen. These are but a few of the benefits we obtain from the insects, the majority of which are generally considered pests.

The story of the economic value of vertebrate life would mean a part of the commercial history of the world, so essential are nearly all of the higher animals to man and his advancement. We may pass rapidly in review the great fisheries of the globe which afford a direct support to thousands, from the salmon canneries of Alaska to the tunny fishermen of the Mediterranean.

The sharks, valuable scavengers, provide the makers of swords, belts, and various fancy articles with leather, the teeth being made into fancy and cheap jewelry. On the New England coast the small sharks or dogfish are in demand as guano, the fisheries giving employment to hundreds of men during the summer months. The oil of nearly all sharks is a commercial commodity, while the shark fin is a delicacy to the Chinese and collected by the ton from Catalina to China.

The torpedo ray has been utilized by science, and the electric catfish of Africa is sometimes employed as a medicine.

The Volga sturgeon fisheries give employment alone to over one hundred thousand persons, while that of our Alaskan coast is an important and growing industry. Helmets are made from the porcupine fish. The oil of the sunfish is valued in medicine. Shagreen comes from various fishes; leather and isinglass from the cod, hake, and haddock, weak and drum fishes; while the scales of the tarpon and parrot fishes are employed in ornamentation. Carp, dace, tench, and other fishes generally considered of little value, produce scales from which artificial pearls are made, and so become factors in a large and growing industry, especially in France.

The importance of fishes as food need not be mentioned. In the mere enumeration of useful products of animals but a faint idea can be gained of the vast interests they present. The National Museum, under the direction of the late lamented Prof. Goode, arranged a collection which illustrates the value of fish and fishing in all the details from the jewfish, that is made into boneless cod, to the feather fly, whose manufacture gives employment to hundreds of women and girls in New York.

The products of fish give rise to numerous industries, among which may be mentioned isinglass from the sturgeon; caviare; leather from eelskins, and guano from catfish. Then come the trades associated with the capture of fishes—the dealers in fishing tackle, the builders of fishing boats, the makers of fishhooks, sinkers, and artificial bait being a few that will suggest how the fishes indirectly enter into the life of man and aid in his support.

Passing to the reptiles and their allies, we find the frogs and lizards destroying noxious insects, ridding the gardens and trees of pests. The skin of large snakes is made into leather; that of smaller varieties into belts, hatbands, covering for boxes, etc.; while snake oil is highly valued for various purposes. In South America the white meat of the great boa is esteemed a delicacy. A political economist, whose name I do not recall, has stated that wars are a necessity to kill off the surplus population. This philosopher would probably consider the snakes of India in the light of a benefit, as since 1870 they have destroyed over two hundred thousand natives.

We obtain our real tortoise shell from the hawksbill turtle, the beautiful substance being made into countless articles, forming important industries in themselves. The Florida crocodile and alligator are on the verge of extinction that we may have satchels and the hundred and one objects in this leather which the ingenious makers give us. Every portion of the animal is of value. The teeth are made into jewelry, the oil soothes the rheumatic patient, while alligator musk forms an ingredient in the manufacture of perfumes.

The direct benefits which we obtain from the birds are well known. The egg, poultry, and wild game industry, the sale of pet birds, the extravagant use of plumes and feathers at the dictates of fashion, the sale of birds and eggs for specimens, the manufacture of fly-fishing bait, are but a few industries which afford employment to thousands all over the world and represent the investment of vast sums of money. Some of the peculiar products of birds are leather from the feet of tropic species, the albatross; pipestems from the leg of the latter; quill pens, penguin-feather furs, and penguin skins as fuel at Heard Island; the oil of gulls as lamp oil by Eskimos; leather from the pouch of

the man-of-war bird; and tobacco pouches from that of the pelican. In heathen China the beautiful little quail is used by noble ladies to warm the hands in winter, and in civilized America live pigeons are used as a target by our so-called sportsmen. Many birds are becoming extinct, due to the demand for them by exacting fashion. Every hummingbird, bluebird, heron, or curlew in California and Florida has a price upon its head.

A value which birds have to man should not be omitted, namely, their work in distributing seeds, thus aiding in rendering islands habitable for mankind. This can be illustrated by the work of pigeons at the Moluccas. The Dutch destroyed all the nutmeg trees except those on the island of Great Banda, but were obliged to send a yearly commission to cut down the trees which grew from seeds transported to the island in the crops of the fruit pigeons. Coffee and other seeds are transported in the same way.

Among the higher or milk-giving animals there is hardly one that is not of some distinct value to man. The fur-bearers are well known, from the fast-disappearing fur seal to the common cat, over a million skins of which are used every year in the trade and sold as Alaska sable; six million squirrel skins are used by furriers every year, while thousands of common ratskins are employed in the manufacture of kid-glove thumbs. Muskrats contribute three million skins annually to the trade, and musk as well. The skunk, kangaroo, and other little suspected animals are all important factors in trade. Among the singular leather producers are the raccoon, peccary, cat, dog, for drumheads; white whale, which is dressed as kid, velvet, or plush; porpoise, and hippopotamus.

Every portion of almost every animal is available for the requirements of man: parchment from the viscera of seals and bears, gold-beater's skin from those of the ox, and catgut from those of the sheep. The hair of many animals is used in an infinite number of ways, from that of the skunk in fine brushes to that of the badger, dog, camel, hog, and others for coarse kinds. From the hoofs, bones, and horns of animals comes gelatin, used in the manufacture of court-plaster, jelly, and artificial flowers.

The oils of the milk-givers represent a vast interest. Some of the most singular are porpoise-jaw oil, used in lubricating fine watch machinery; manatee and dugong oil and dog oil in the manufacture of kid gloves. From many of these fine soaps are made. Some of our perfumes are obtained from certain animals —as the muskrat, musk ox, civet cat, musk deer, and beaver.

The artist looks to various animals for fine colorings. Ivory black, used in the manufacture of bank-note ink and in fine paintings, comes from bones; while Prussian blue is made from hoofs and refuse hair. The gall produces a dye, and from blood comes

the turkey red of printers. The chemist depends upon animals to a large extent. Portions of the dog are used in tanning hides; albumin of the blood in refining sugar and various secretions in printing calico; while the chemist finds pepsin in the stomach of hogs and calves. Phosphorus for matches is taken from bones; the physician obtains his vaccine lymph from cows, by this means saving thousands of lives; while ammonia and lime are common products from bones and horn.

Among the special animals that are of great value to man is the whale. In 1884 a single animal sold for over fifteen thousand dollars, the oil bringing $3,490, the bone $12,230. Besides these products there is the ambergris, a secretion in the intestine; the valuable ivory of the teeth used by the Japanese in their carving; the skin as leather; the bones for knife handles and for various purposes.

The delicate mole is a valuable aid to the agriculturist. An individual will eat twenty thousand grubs in a year, while the fur is highly esteemed. The fur dealers use nearly ten million skins of rabbits and hares a year. Twenty thousand bears are sacrificed yearly, the hides being employed as leather, and even teeth for Indian chisels, knives, and ornaments. In 1880 the trade absorbed seven hundred tons of elephant ivory, one hundred thousand of these noble animals being killed that we might have billiard balls, chessmen, carved figures, and countless other objects for use and ornament.

The furs of animals keep us warm in winter, while the wool of our under-garments comes from another group representing vast industries giving support to thousands of persons.

Statistics in which this paper abounds are dry and uninteresting, but they alone tell the story of man's dependence upon the lower animals. One hundred thousand Persian lambskins are used annually by the trade; six hundred thousand Astrakhans and two hundred English skins—suggestive of an array of workers.

From the goat come mohair, cashmere; while the interesting Angora goat, which has been introduced into California, produces fifteen million pounds of wool per annum; every hoof, hide, and horn has its value in the great world of trade. The camels and their allies produce the hair for shawls and other valuable articles of wear.

The demand for objects of luxury is tending to the extinction of some of our most valuable animals. The buffalo has been almost wiped from the face of the earth, that we might have sport, robes, and buffalo tongue. The five hundred lion skins which the trade uses annually for rugs and leather have marked the royal cat for early extinction; while the rhinoceros, giraffe,

tiger, elephant, and many more will doubtless be known to our descendants a century hence by their pictures in books and their remains in the museums of the day.

This great question of the economic value of animals is of radical importance to every citizen. It should secure our thoughtful attention, and be taught in our schools and colleges. We should demand from the Government absolute protection to the fur seal; our humane societies, which have accomplished so much, should extend their good offices to the protection of song birds, the wild game of our forests, and to all animal life.

SKETCH OF LOUIS FIGUIER.

By IDA M. TARBELL.

WHO in America, reading twenty years ago, does not remember The World before the Deluge? It was translated from French into English at a time when the great call in our schools was for more science; when the ministers in numbers of pulpits were "reconciling Genesis with geology," and when boys and girls of fifteen were observing strata and fossil plants and animals as they never had before. Its direct statements, its vivid pictures, above all its exciting reconstructions of primitive epochs—a Silurian age whose principal inhabitant was a tranquil trilobite; a carboniferous era rich in giant ferns and "horsetails"; a Jurassic, whose terrible denizens, ichthyosaurus, plesiosaurus, pterodactyl, haunted the dreams—caused it to be read by hundreds of young people. There are many men and women in America who can trace their first interest in geology to that work, or to some one of those in the series to which it belonged.

The author of The World before the Deluge, M. Louis Figuier, it was my fortune to meet frequently in the winter of 1893 and '94 in his home in Paris, and the announcement of his death a few months ago led me to believe that many American readers might be interested in the recollections I have of our conversations and in the impressions his curious personality made upon me. M. Figuier was one of those men whom the popular fancy had wearied of and dropped, and who, unable to understand why he was not as thoroughly in touch with his generation as ever, insisted tenaciously on being heard.

The modest apartment of M. Figuier, like the house, was of a past generation. Its vestibule, whose walls were covered with the light striped paper in vogue long ago, and hung with family portraits in fading crayon and water colors, was furnished with

an ancient hat tree. Its *salon*, carpeted with a dark-green Brussels, such as was in style in the United States perhaps forty years ago, was decorated with numbers of flower pieces, huge wreaths and bouquets, after the manner in which our mothers did their water colors. They were framed in narrow black or gilt moldings, and some of them still bore in the corner the numbers they had borne in the *salons* of the sixties.

As for M. Figuier, he had all the alertness, the decision, the energy of the life which surged all about and invaded the street in which he dwelt. In spite of his seventy-five years his form was tall and straight; his bearing was that of an officer rather than that of a writer; in his white face was none of the effacement of character so often seen in the old, no letting down of moral and physical self-control; his eye was ardent, indignant, sad by turns; his speech eloquent, rapid, full of conviction, impatient of contradiction. Yet one saw that he was, like the old houses of the Rue Caumartin, "condemned." His bitter protest against the way in which the journalism of the day treats the popularization of science, his persistency in regarding himself as the one and only popularizer; his despair at the good-natured raillery which the hobbies of his old age had called out, all showed that M. Figuier was out of touch. This mingling of generations, this refusal to believe that his work was done, gave me from the first of our acquaintance an interest in the fine old man which was half pathetic, half humorous.

I have never known a person whose origin and early education were more evident. He proved his southern birth—he was a Languedocian—by his fervor, his imagination, his astonishing plans. He showed his Huguenot parentage by the strength of his convictions.

But these things did not explain why, at thirty years of age, he should have left an excellent position as a professor, after having spent years in the universities of Montpellier and Paris preparing for it, and after having begun and succeeded in original investigations, to become a popularizer of science.

It struck me that a man of his evident pride and culture would have a justifiable satisfaction in remaining among *savants* and in pursuing the conventional path of university work, especially after he had acquired a sure footing. Why did not M. Figuier accept the scholar's career in which he was so well launched? Why did he take up popularization? I asked him one day.

"It was simple enough," he said. "It is true I had taken my degrees and had a good position, but I had the idea that scientific knowledge, which until then had been almost exclusively the property of the learned, should be put within the reach of the

reading public, that the people should be enabled to share the fruits of scholarship.

"I was convinced that no one should attempt to do this sort of work but a man of thorough scientific training. I had done all the work the schools offered. I had been a professor. I had made some original researches. I felt that I had a right to attempt to explain in a popular style the wonders of science. My first book, on the Principal Modern Scientific Discoveries, was a success, and I immediately arranged to continue the work. My colleagues blamed me, and said I was belittling science, but I was convinced the thing ought to be done, and I made up my mind to do it if possible.

"In 1855 I began to write scientific letters for *La Presse*, which under Émile de Girardin was one of the most important papers of Paris. But I soon found I had too much to do. The university or the popularization must be given up. I chose the latter. There were plenty of men willing to do the exclusive work of the former; there was only myself willing to use my training for the press. And that is how I became a journalist."

He never referred to his early journalistic experience without recalling the brilliant circle which he entered when he became a member of the staff of *La Presse*. It needed only the suggestion of a name then to get his characterization of many a famous man or woman. He would clasp his hands and lift his eyes. "Ah, those were great days! Victor Hugo was living then, you know. The year I joined the staff of *La Presse* Théophile Gautier was doing its dramatic work, Lamartine was running his Cæsar as a *feuilleton*, and George Sand the Story of her Life. It was around such a nucleus that the Girardins gathered all that was brilliant in Paris into their *hôtel* in the Champs Elysées."

M. Figuier continued writing popular scientific books after he began journalism. The familiar *Année Scientifique*, which he conducted till the end of his life, was his first venture. It was followed by the Pictures of Nature, the first of which, The World before the Deluge, has been alluded to. This series incuded nine volumes, reviewing the meteorology, physics, mechanics, and chemistry of the globe.

One day when we were talking about the books he said: "I had an ambitious idea in beginning that series. I wanted to chase lying out of the schools."

"Lying?"

"Yes, lying. What are mythology and fables but lying?"

"But——"

"False, all false."

M. Figuier never allowed me to oppose him. He rose and took down one of the volumes, opened to a preface, and read me with many a gesture and with increasing warmth of tone the following observations:

"The first book to put into the hands of a child should treat of natural history. Instead of calling the attention of young minds to the fables of La Fontaine, the adventures of Puss in Boots, or the Twelve Labors of Hercules, they should be directed to the simple and naïve pictures of Nature—the structure of a tree, the composition of a flower, the organs of animals, the perfection of crystalline forms. It is because the nourishment of the young has been falsehood that the present generation includes so many false, feeble, and irresolute minds.

"If I live a hundred years I shall never forget the frightful confusion into which the reading of my first book threw my young head. It was an abridgment of mythology; and you know what one finds there: Deucalion, who creates the human race by throwing stones over his shoulders; Jupiter, who cracks his skull and lets out Minerva and all her accessories; Venus, who one fine morning is born from the sea foam; old Saturn, with his vicious habit of eating his children; and all the rest of that Olympus where the gods and goddesses commit so many bad actions. How can the head of a four-year-old resist such an upsetting of common sense?"

And so M. Figuier wrote his nine big volumes. Unquestionably they have contributed to interesting the young, not alone of France but of a large part of the world, in the phenomena of Nature; and if they have not yet driven out La Fontaine, Perrault, Mother Goose, and the fascinating inhabitants of Olympus, they have at least entered into healthy competition with them.

His great hobby as a literary worker was system. "System, classification," he would repeat, "it is through them I have done my great work. Every note I take goes into its proper place. So with everything I own. You have asked for data of my life. I can give them to you without looking! See here!" He opened a drawer in a cabinet in the room, and out came a great bundle of clippings—press notices on his work, reviews of his books, sketches of his life. A goodly number of them were American.

"Yes," he said, regarding them with a frown, "I get press notices from America by paying an agency, but that is all. My books have been steadily reproduced there for thirty years. See here, notice after notice of my last book, Happiness beyond the Tomb, and I have been unable to get even a copy of the translation."

It was while pursuing his favorite subject of "system" that M. Figuier revealed to me the great passion of his life.

One day he had led me into the vestibule where there were two large cases running to the ceiling. They contained numberless boxes of notes, all labeled. Here were all the subjects M. Figuier treated. At a moment's notice he could have under his eye all that he had accumulated on any subject which interested him. While listening to his enthusiastic explanations I noticed on one shelf a number of neat manuscripts.

"What are these?" I asked.

"My theater," he said, with a tender regard. "There are the plays, mademoiselle, which are going to teach the world science as it was never taught before. There," he continued, warming, "is the greatest of all methods of scientific popularization. Nobody understands it; nobody supports it. The press will not recognize it. New ideas are choked to death in Paris by the jealousy of journalists. These plays have been represented before audiences which were wild with delight. Ah! but they are beautiful! But jealousy keeps them back."

"There is one on your countryman Franklin and electricity; here is another on how Morse got his appropriation bill through; here is one Bernhardt has read and promised me to play. She says it is superb, *superb*. It is on Catharine of Russia."

"And some of them have been given?"

"Nearly all, at my expense, understand. I believe it is one way to teach science to the people, and I mean to do all I can to push it. Here are two volumes of plays which I have put on at much cost. One season I hired a theater for a series of scientific matinées. Again I made a tour of the provinces with a troupe. I have given ten years of my life and spent my fortune for this idea. Once I lived in a *hôtel* in the Champs Elysées, now I am *here*." And he looked scornfully around the modest room with its faded air. "I have given it *all* for my theater."

The pain of the man was too intense, his earnestness too profound, for me to probe deeper into this defeated passion of his old age, and I waited until a free hour in the Bibliothèque Nationale gave me leisure to discover just what M. Figuier's theater was. I found it was just what he said—an attempt to teach science by means of the drama. He argued in this way:

"Works of popular science contribute to dissipating the popular superstitions, concerning thunder, for example; but the book is silent and cold. A theatrical representation which shows the spectator the physical phenomena connected with thunder and lightning, under a striking and material form, will impress much more deeply.

"Besides teaching the laws of the physical and natural sciences, scenes from the lives of celebrated *savants* should be represented. Instead of taking, for the hero of a play, Cromwell, Riche-

lieu, Louis XIV, Mazarin, take Denis Papin, Gutenberg, Kepler, Benjamin Franklin, Robert Fulton. Before my time no one of these persons had been made the subject of a play, simply because dramatic authors are unfamiliar with the events in the lives of naturalists and physicists. Nevertheless, illustrious *savants* are just as good as political or military personages for dramas or comedies. A *savant* is a man. Like every man, he has had his hour of youth and of love, his moments of sorrow and of bitterness. Because he has enriched his age and country by an immortal work is he less interesting than an imaginary personage? There are in the different periods of the lives of all *savants* subjects for dramas or comedies, situations capable of moving, of exciting to laughter or to tears."

A word on a few of the plays of M. Figuier will show how he carried out this theory. Take the "Marriage of Franklin," which turns around the difficulties which Franklin had to surmount to secure Miss Deborah Read. The tricks which electricity plays at the last moment untie the complications. A complete series of the physical, mechanical, and physiological effects of thunder and lightning are worked into the play.

"Miss Telegraph" portrays the situation of Samuel F. B. Morse before the passage of the bill appropriating money for carrying on his experiments on the electric telegraph, and describes the means by which Miss Ellsworth succeeded in getting the bill through at the last moment.

"The Blood of the Turk" is a "Mr. Isaacs" situation, showing what may result from the infusion of foreign blood into the veins of an old man. The hero has been treated with the blood of a Turk, and finds himself in the extraordinary situation of being half the time a passionate, quarrelsome, amorous Oriental, the other half a weak old man without the courage to fight the duels the Turk has provoked, the appetite to eat the meals the Turk has ordered, the gayety to do the love-making for which the Turk has contracted.

The "Six Parts of the World," in the style of Jules Verne, characterizes the five continents of the globe and discovers a sixth. Dumont d'Urville is the hero, and his expeditions to the south pole form the plot of the play. Lessons on navigation and discoveries, on desert fevers and phosphorescent beetles, on the customs of Madagascar and Australian progress, on American business methods and the character of the lands at the south pole, are all included in five acts.

One day, some time after I made the acquaintance of M. Figuier's theater, I asked him if he believed his idea would be carried out in the future.

"I expect to carry it out myself," he said sturdily.

"Yourself?" I exclaimed.

"Oh, not here, not here," he said quickly. "Beyond the tomb. I may fail here, but I shall take it up again when I am dead. I am persuaded that it will be easy to carry out there this idea which has occupied me so seriously here. Do you suppose we are going to be idle there? Not at all. We are going to do what we loved to do here, and do it perfectly, as we have longed and dreamed to do it."

"Do you really believe that?"

"Believe it? Of course I believe it! Does one put into a book what he does not believe? I have put all that into *Les Bonheurs d'Outre-Tombe*. Does a man at my age talk of what he does not believe? At seventy-five one tells the truth.

"Why should I not believe it? Nature indicates a future life by all her transformations, common sense preaches it, common justice demands it, and if we live again we shall work. Do you suppose the good God is going to leave us with our aspirations unsatisfied? No. Victor Hugo is writing better romances than he ever wrote here, and De Musset better poetry." Then, glancing at the water colors on the walls, "My wife is going on with her pictures, and there I shall succeed with my theater. Why," he cried, with a passionate conviction which was almost awe-inspiring, "that belief is the consolation of my life!"

He based his theories of the future life on no religion. It is modern philosophy based on science and reason, which in his judgment promises a future life. But this promise is only to the upright, who in this world practice righteousness and cultivate their minds. They after death take on the attributes of superior beings—that is, become what M. Figuier calls "*êtres surhumains*," or, in ecclesiastical parlance, angels.

On escaping from the body the new being becomes an inhabitant of the interplanetary spaces. Here all his faculties are quickened to an extraordinary degree, the secrets of Nature are clear to him, social problems are solved, all those whom he has loved on earth and who have died join him. The natural gifts which he has had no opportunity to cultivate on earth have full play there. Unfinished work is completed. He is in relation with the great and wise of all the ages. If he continues in this new sphere to do good and to cultivate his intellect—that is, if he works to raise his soul to perfection—he will be advanced to a superior realm of the sky, where the beings are of a still higher intellectual capacity and possess more numerous faculties.

As he loses more and more of the material element, he ascends higher in the scale of the elect. After passing two series of these celestial progressions and promotions, of which it is impossible to know either the number or the length, the soul arrives at a state of pure essence, and penetrates into the center of our solar sys-

tem, the sun, whose inhabitants, possessing immortality, form a part of the divine government ruling over this portion of the astronomical system.

To merit such superior happiness man must apply himself during his life on earth to perfecting himself, to purifying his soul, loving his neighbor, spreading happiness about him, increasing his knowledge. He who, on the contrary, perseveres in injustice and ignorance will be condemned to recommence his earthly career, and that again and again until he is fit to leave this globe.

One attractive feature of M. Figuier's interplanetary heaven which he develops in his book is the novel means of travel he imagines to exist there. "Since science," he writes, "excuses itself from explaining the nature of the comets and the rôle they play in the universe, it is permitted to the imagination to say a word on the subject.

"Is it forbidden to believe that certain comets, notably those that return into our solar system, are agglomerations of superhuman beings which have just finished a voyage in the profound depths of the sky and end their trip by returning into the sun? According to this hypothesis, these comets are pleasure trains made up of the inhabitants of ethereal spaces."

In the last conversation I ever had with him I asked him, just as I was about to say good-by, "M. Figuier, do you really believe in your comets made up of souls?"

His stern face lighted up. "Ah, my excursion trains! Who knows? who knows? Perhaps I shall travel in one. But that, you know, is imagination."

And when we rose to leave the *salon*, and I stopped to regard for the last time the gay wreaths and bouquets on the walls, he added with a nod of complete conviction, "But of one thing I am sure—there I shall succeed with my scientific theater."

M. VALLOT'S observatory, on the Rocher des Bosses, Mont Blanc, about fourteen thousand five hundred feet above the sea, has developed into a really comfortable abode of eight rooms, furnished with adequate means of keeping out the cold and the snow and with conveniences for housekeeping. The walls and windows and outer door are double. The house has a kitchen and shop near the entrance; a room for guides, with five beds; a provision room; a director's room, with two beds; a registering room; a photograph and spectroscope room; a guest chamber, with three beds; and a physical laboratory. A peculiarity of the kitchen utensils is the construction of the kettles to compensate for the lowered boiling point of the mountain height. The observatory, instituted in 1890, was at first devoted to meteorology; but since the new observatory was erected on the summit, more attention has been given in it to terrestrial physics.

Editor's Table.

MEETING OF THE AMERICAN ASSOCIATION AT DETROIT.

THE American Association for the Advancement of Science had a very pleasant meeting at Detroit. Socially it was all that could be desired, and was perhaps in this respect among the best in the history of the body. The people of Detroit, who call their town "the Convention City," and are proud of the hospitality they show to the assemblies that visit them, strove to outdo themselves in entertaining their guests, and, what with the lunches they served and the receptions and excursions they gave, made the occasion a brilliant one. The high-school building, in which the association met, was one of the best it has occupied, for it amply accommodated all the meetings and furnished room for doing all the work under one roof.

The association suffered from the absence of its designated president, Prof. Wolcott Gibbs, who was kept at home by illness. His presence would have lent it much dignity, and would have recalled its older and best days. His place was taken by Vice-President McGee, who discharged the executive and administrative duties of the office satisfactorily. A happy feature in the opening meeting was the felicitous address of General Palmer, who, although not a man of science, evidently appreciated its value, and knew well how to fit his remarks to the occasion. The memorial address on Prof. Cope, by Prof. Theodore Gill, was perhaps the feature of the whole meeting which most deserves notice and will be remembered longest. The president's address and the addresses of the chairmen of the sections were well-wrought-out presentations of their several subjects, creditable to the speakers and to the association. Of the papers, the majority appear to have been technical. Of the others, some were very good, and some, we are constrained to say, should have no place in the proceedings of such a body as the association ought to be.

The attendance was not large; the whole number of registered members being only two hundred and ninety-one.

An important new step was taken in making the nomination of officers by the council and its nominating committee valid without further proceedings. Heretofore the nominations have been subject to approval by the association. The joint meetings of affiliated societies with sections of the association, of which there were several, were a feature to be commended.

The meeting made more prominent the fact which has been evident for many years, that our strongest and most experienced men of science are losing their interest in the association. They seem to have all the field for work and distinction they want in their own separate organization, which does not reach the people at all; while this field, in which they could gain quite as much repute, add fully as much to knowledge, and contribute vastly more to its diffusion, they neglect. It is hard to conceive a nobler or more desirable way in which the student of Nature can contribute to the instruction and elevation of his fellow-men than by giving his support to this body which courts the sym-

pathy of the people, and by going from place to place seeks to instruct them in their very homes in the highest achievements of research. There can hardly be a more effective way of promoting the advancement of science than by these meetings, now here and now there, through which the beauties of knowledge are disclosed to the public, and the thirst for its acquisition and extension is aroused in whole communities at a time. The greatest scientific lights of Great Britain, France, and Germany love to do this. Thus, at the meeting of the British Association just held at Toronto, we have seen such men as Lord Kelvin and Lord Lister, Sir John Evans, and a dozen others of almost corresponding prominence, present, as interested and taking as active a part as if they were younger men still having their spurs to win. Other men, in their respective days of equal standing in science with these, whose books are standard authorities wherever the English language is spoken, have habitually attended the previous meetings of this body because their heart is in the work of making the whole world sharers in the benefit of what they have been able to discover. We can not but think that the eminent students of America who fail to do likewise are committing a great mistake.

THE TORONTO MEETING OF THE BRITISH ASSOCIATION.

THE British Association for the Advancement of Science has now, for the second time, held an annual meeting on this continent. In the year 1884 it met at Montreal; this year it met at Toronto. The Montreal meeting was not, on the whole, considered a very successful or in any way notable one; but this year conditions and circumstances seem to have proved more favorable, and we believe the Toronto meeting will be remembered with much satisfaction by all who took part in it. Toronto, as a city, is well adapted for convention purposes, and the noble grounds and buildings of Toronto University formed a most admirable and charming focus for the work of a learned assembly. The visitors were favored also with the very finest weather which the climate of this continent is capable of producing; and that helped not a little to put every one in good spirits and give animation to the proceedings. Great names were not wanting amid the throng. The retiring president, Lord Lister, whose name all the world honors, was there to hand over his office to the distinguished archæologist Sir John Evans. To see Lord Lister and hear the tones of his voice is to recognize in him the friend of human kind—a noble example at once of scientific eminence and moral greatness. Lord Kelvin, too, was there with his earnest, kindly, unassuming manner and wonderfully penetrating intelligence—a man who bears his great honors meekly, as becomes one whose fame rests upon a sure foundation. Michael Foster was also present, a man who has trained and inspired with something of his own zeal a whole generation of physiologists at the University of Cambridge. Biology was further represented by such men as Profs. L. C. Miall and Lloyd Morgan; physics, by Oliver Lodge and Sylvanus Thompson; chemistry, by Prof. W. Ramsay, of argon fame; geography, by Mr. J. Scott Keltie; political science, by the Right Hon. W. Bryce, author of The American Commonwealth. We name but a few; there were men of eminence and merit on every hand.

Associated with their scientific brethren from England, and taking a prominent part in the proceedings

of the association, were many of the foremost scientific workers in this country. Among these may be mentioned Profs. Morse, Newcomb, Remsen, Hadley, Putnam, and Chamberlin. A few associate members came from foreign countries. The Canadians contributed their quota of men of distinction, and altogether the gathering partook to a pleasing extent of an international character.

As usual, on such occasions, liberal provision of time was made for social hospitalities and semiscientific excursions; but the serious business of the association was well kept in view. The inaugural address of the incoming president, Sir John Evans, consisted of a plea for the recognition of archæology as entitled to a place among the sciences. He had no difficulty in showing the aid which the archæologist is able at times to render to the geologist, and also the assistance it affords toward a scientific treatment of history. His account of the evidence accumulated within the last thirty or forty years as to the antiquity of the human race was clear and succinct. He did not consider the existence of man in Miocene times proved, but he spoke of the "almost incredible length of time" occupied by the Palæolithic period. "We may not know," he said, "the exact geological period when palæolithic man first settled in Britain; but we have good evidence that he occupied it at a time when the configuration of the surface was entirely different from what it is at present; when the river valleys had not been cut down to anything like their existing depth; and when the fauna of the country was of a totally different character from that of the present day." The time covered by that period was sufficient, he stated, to permit of "the erosion of valleys, miles in width, to a depth of from one hundred to one hundred and fifty feet. . . . When we take into consideration," he added, "the almost inconceivable ages that, even under the most favorable conditions, the excavation of wide and deep valleys by river action implies, the remoteness of the date at which the Palæolithic period had its beginning almost transcends our powers of imagination." Sir John Evans speaks with the authority of a man deeply versed in geology as well as in archæology, and it is safe to assume that he speaks within bounds.

Among the Presidential Addresses to the Sections were several that were weighty and valuable. Prof. Michael Foster reviewed most instructively the progress of physiological science in the dozen years that had elapsed since the association had last met in Canada. He sounded a not unneeded note of warning against allowing commercial considerations to predominate in questions of research. "There is an increasing risk," he declared, "of men undertaking a research not because a question is crying out to them to be answered, but in the hope that the publication of their results may win for them a lucrative post." A greater evil still, he considered, was the locking up of scientific discoveries for the private enrichment of the men who had made them. Another observation of general value was to the effect that scientific controversy is never wholly valueless, since "the tribunal to which the combatants of both sides appeal is sure to give a true judgment in the end." The great progress, he stated, that had been made in the study of the conditions and aspects of life in the higher animal forms had rendered much more hopeful the study of life in its lowest and most generalized forms; so that there is good reason to anticipate that "in the immediately near future a notable advance will be

made in our grasp of the nature of that varying collection of molecular conditions, potencies, and changes, slimy hitherto to the intellectual no less than to the physical touch, which we are in the habit of denoting by the word protoplasm." Here "the animal physiologist touches hands with the botanist, and both find that under different names they are striving toward the same end." The learned professor recognized that it would be inopportune "to plunge into the deep waters of the relation which the body bears to the mind," but this, he declared, we know, "that changes in what we call the body bring about changes in what we call the mind." If, therefore, in the coming years a clearer knowledge shall be gained of "the nature and conditions of that molecular dance which is to us the token of nervous action," and if "a fuller, exacter knowledge of the laws which govern the sweep of nervous impulses along fiber and cell give us wider and directer command over the molding of the growing nervous mechanism and the maintenance and regulation of the grown one, then assuredly physiology will take its place as a judge of appeal in questions not only of the body but of the mind; it will raise its voice not in the hospital and consulting room only, but also in the senate and the school." These are eloquent words, but their eloquence is the least part of their merit; the preponderant part lies in the truth they contain—a truth which at this very moment it has become urgently necessary to proclaim in face of the fanatical doctrines of the absolute supremacy of mind or spirit which are running like wildfire through certain sections of supposedly educated communities.

Wherever scientific men congregate there the name of Darwin is sure to be mentioned with honor. Prof. Foster, in the address to which we have just referred, spoke of his "pregnant ideas" as having "swayed physiology in the limited sense of that word as well as that broader study of living beings which we sometimes call biology, as indeed they have every branch of natural knowledge." The President of the Anthropological Section, Sir William Turner, spoke of the "enormous impulse given to the study of the anatomy of man in comparison with the lower animals by Charles Darwin's ever-memorable treatise on the Origin of Species." According to the President of the Botanical Section, Prof. Marshall Ward, whose address yielded to none in the wealth of interesting facts and principles it unfolded, recent comparative studies, both of existing and of fossil plants, "are yielding at every turn new building stones and explanatory charts of the edifice of evolution on the lines laid down by Darwin." Not less ample were the acknowledgments of the value of Darwin's work made by Prof. Miall, President of the Zoölogical Section. "I do not," he said, "lay it down as an article of the scientific faith that Darwin's theories are to be taken as true; we shall refute any or all of them as soon as we know how; but it is a great thing that he raised so many questions that were well worth raising. He set all scientific minds fermenting, and not only zoölogy and botany, but paleontology, history, and even philology bear some mark of his activity. We owe as many discoveries to his sympathy with living Nature as to his exactness or his candor, though these two were illustrious. A young student anxious to be useful may feel sure that he is not wasting his time if he is collecting or verifying facts which would have helped Darwin."

Apart from his reference to Darwin, there were many interesting

and valuable observations in Prof. Miall's address. He dwelt with proper force on the impossibility of obtaining a living insight into biological problems or even a living acquaintance with biological facts by means of text-books and lectures alone. He indicated the necessity of extreme care in talking of the "laws of Nature," lest some false idea of a positive mandate should creep into the mind. He expressed himself as accepting in great measure, but still in part only, the "recapitulationist" theory, as it has been called, of embryonic development. He believes that the mammalia certainly had a piscine origin in remote ages, but professed himself unable to trace their family record any further back. He does not like the word *must* in the mouth of a biologist. "Whenever any biologist brings the word *must* into his statement of the operations of living Nature, I look out to see whether he will not shortly fall into trouble."

Upon the whole, there was much useful work accomplished at the Toronto meeting. One could not attend the different sections without feeling that the work of science in its different branches is a great and mighty and beneficent work, and one which elevates and liberalizes the minds that give themselves to it with devotion. However lightly these annual gatherings may sometimes be spoken of as being mainly occasions for holiday-making, we believe that they are the means of communicating many useful intellectual impulses both to the working members themselves and to the general public.

Scientific Literature.

SPECIAL BOOKS.

In this fifth volume of the Memoirs of the American Folklore Society are given what might be called the book of Genesis of the Navaho Indians and the shorter legends of Natinesthani and The Great Shell of Kintyel.* The origin legend starts with twelve insect peoples and tells how First Man and First Woman were produced by the gods and cared for by the insect peoples as the gods directed. The history of this pair and of their descendants follows and is filled with incidents designed to explain present customs of the Navahoes and various phenomena of Nature. The last chapter of the legend, dealing with the growth of the Navaho nation, is in part traditional or historical, and many of its dates are approximately correct. The introduction of sixty pages which Dr. Matthews has prefixed to the legends, and his sixty-five pages of notes, contain much material of value to the anthropologist. The Navaho reservation lies in the northern parts of Arizona and New Mexico, and although arid is not a desert. Dr. Matthews tells us how the Indians manage to raise meager crops from its soil, and how they care for their herds of sheep and goats. He also describes the personal appearance of this rather intelligent people and the structure of their various kinds of dwellings, giving portraits of several individuals and views of typical houses. Their industries—weaving, in which they excel, basket making, pottery, silverwork, etc.—are described,

* Navaho Legends. Collected and translated by Washington Matthews, M. D., LL. D. Boston: Houghton, Mifflin & Co. Pp. 299, 8vo. Price, $6.

with pictures of specimens and of Indians at work. Dr. Matthews gives us also some description of the Navaho religion and its ceremonies. The religion is an elaborate pagan cult, and as the tribe inclines to be democratic so does the pantheon: they have no highest chief, so they have no supreme god. There are also evil spirits whom men dread. Many of the ceremonies are of nine days' duration, while others last but a single day or a few hours. Elaborate costumes and other paraphernalia are employed in them, specimens of which are here figured. To learn one of the great rites so as to become its chanter, or priest, is the work of many years. Dr. Matthews has a good word for the medicine men that he has come in contact with among this people. Among the notes are given the words of several songs with interlinear translations, and the music of eleven melodies, the latter having been recorded on the phonograph by Dr. Matthews and noted from the cylinders by John C. Fillmore. In addition to its forty-two cuts in the text the volume contains four plates, of which two are colored.

Mr. Bellamy's *Equality* * takes up the story and the discussion of social questions from where Looking Backward ended, and continues them. It is in the year 2000, and in the conversation in the garden where Looking Backward left the pair, Edith asks Julian West about the old times of the nineteenth century, and is astonished that such things as he tells of could have been. Some of the details of the revolution that changed conditions are explained to him. He opens his account in the National Bank and learns about the new financial system, in which private estates are extinguished, the nation owns all the property, and every citizen is allowed each year an equal credit, in lieu of estate, wages, or profit. Every one is expected to choose some occupation and follow it, and all are expected to do by turns their shares of the unpleasant work which no one chooses. A remedy is described for those who refuse to take their privilege or burden. In all those things, and in dress, women are as men, and changes of fashion are no longer known. A discussion of right of property introduces an elucidation of the theory of the social fund and the doctrine that private capital is stolen from it, and the astonishing declaration that under the system prevailing in the nineteenth century, if one monopolist could have acquired title deeds to all of the earth, he might have ordered the human race off of it. The right of title by inheritance is attacked, but it is argued that the equalization of human interests achieved does not destroy the right of property. It is simply merged in the title of the state. And it is held that by this system of equalization women are delivered from a bondage incomparably more complete and abject than any to which men have been subjected by their fellow-men—the bondage of personal subjection to the husband, and to the tyranny of conventional rules. The profit system is held up as one of economic suicide. Strikers of the nineteenth century are honored in statuary as the leaders in the revolt against capitalism and the pioneers in the new movement. Julian finds that what he had formerly thought evil has become good, and what has seemed wisdom has become foolishness. The iniquity of foreign commerce for profit and the hostility to improvement of a system of vested interests are enlarged upon. While under the old system the continued acquisition of knowledge after

* Equality. By Edward Bellamy. New York: D. Appleton and Company. Pp. 412. Price, $1.25.

leaving school was prevented by the burden of cares that fell upon the man going into business for profit, in the new society the state assumes that burden, and the man can keep on learning all the time. By a constant and immediate referendum the people are able to keep their legislatures under direct and instant control. War no longer exists. The new patriotism looks to the character and purity of the people. Foreign trade is diminished and foreign travel for knowledge increased. Hygienic development has improved doctors out of their occupation. Meat is no longer eaten. Population is distributed out of the cities over the country. The forests have been restored. Farming is done by machinery. The last chapters comprise the history of the supposed revolution, which is assumed to have begun in a revolt against the corruption and monopolies of the nineteenth century and of the solution of the problems it raised.

We wake from the reading of the book to find that we are still in the nineteenth century, suffering from all its faults.

The popular idea of Russia is that of a country inhabited by two classes: first, the military and civil minions of the Czar, who carry out the oppressive edicts of their master with fierce satisfaction; and, second, the people, who submit to this tyranny in constant sullen fear, the brightest among them being generally occupied with plots of assassination. A moment's reflection ought to convince any intelligent person that there is another side to the shield, but everybody does not stop to reflect. The book before us shows the other side.* Mr. *Logan* had a good time in Russia, and he saw many thousands of Russians having a good time. He attended the coronation ceremonies as one of the diplomatic party from the United States, and, although this brought him in contact only with the official and noble class, who have reason to be contented, one could not go about as much as he did at a time when the common people thronged to the splendid ceremonials without seeing a great deal that throws light upon the real condition of "Ivan," the peasant. Mr. Logan recounts the incidents of travel, and describes the stores, streets, conveyances, and other things that one sees in passing with a humor and unconventionality that are delightful. He has grouped many of his observations by subjects. Thus, in a chapter on The Breaking of Russian Bread, he describes the diet and the dishes of both nobles and peasants, with digressions on hunting and fishing. There is much French cookery in Russia, and there are also many distinctively native dishes, some of which Mr. Logan is able to praise enthusiastically. Other chapters describe a village of peasants, Russian horses, the Russian church, Slavic art and literature, and tell "How we kept house" and "How we washed in Russia." The bath-tub of America is a stranger to Russian domiciles, but there are public establishments where the real Russian bath is enjoyed by all classes of the population. In every village there is a bath-house in which the peasants steam themselves at least once a week. But the chief subject of the volume is the coronation ceremonies. Mr. Logan portrays for us the splendid processions, the impressive ceremonies, and the magnificent banquets, balls, and performances. He and his friend "G——" were blest with a courier who was constantly making mistakes that brought them into better positions than they were entitled to.

* In Joyful Russia. By John A. Logan, Jr. New York: D. Appleton and Company. Pp. 275, 12mo. Price, $3.50.

In this way they saw the imperial infant and passed through the throne room, where the crown jewels were displayed, on the day of the coronation. They were put out of this room with a courtesy that they found everywhere unfailing among Russian officials—an officer chatted with them a few moments, and then politely offered to send some one to show them the way to the diplomatic tribune. Mr. Logan tells also of the feast, the juggling shows, and other things suited to their tastes that were provided for the common people. He finds that the lower classes have many privileges and a great deal of liberty, and that they have as intense a loyalty as their heavy natures are capable of. The occurrence at the people's *fête* on the Khodynskoe Plain, which threw the only cloud over the joyousness of the coronation, was not an unmixed evil, for it gave Nicholas II an opportunity to show kindness to his people that justified them in calling him "the Little Father." There is much more in this book than we have space to enumerate. The illustrations deserve more than the word we can give them. There are nearly fifty pictures of buildings, interiors, distinguished personages, and types of the population, besides which there are colored portraits of the emperor and empress and views of the cathedrals of St. Basil and of the Assumption in Moscow.

GENERAL NOTICES.

*An Experiment in Education** is a suggestive little volume setting forth, in about two hundred and fifty pages, the experiment of a thoughtful teacher in introducing young children at once into the elements of knowledge along novel lines of instruction; and it touches furthermore on the principles underlying the experiment. Readers of Appletons' Popular Science Monthly are already familiar with the main ideas of the book, two of the chapters dealing with the actual experiment in Boston and in Englewood, Ill., having appeared as separate papers in previous issues of the magazine. The author, after teaching for ten years in high and normal schools, found that from "one half to one third of the time allotted to a subject had been spent in teaching the student how to use his mind, to use books, specimens, etc.—in other words, how to study. This waste was irritating and pitiable in view of the short time allowed to subjects, and I could not be reconciled to the notion that an adult mind must so generally lack power to work economically, trustworthily, and discriminatingly." To overcome this deficiency, and to ingrain into the mind of the child from the very start habits of accurate observation and independence of judgment, became the object of the teacher; and natural-science studies, as lending themselves most readily to object lessons, where the child could be taught to observe facts and to verify his experience, were made the basis of instruction. Reading and writing were taught by means of the blackboard, and the children constructed their own primers and copy-books out of the material drawn from their science lessons. Thus, instead of wasting time over the mere tools of learning or trite facts of everyday life, they from the very start became familiar with the elements of knowledge. In place of text-books, the Socratic method was applied—drawing out of the children by skillful questioning the facts they were to observe. Instead of taxing the memory with useless lumber, the eye was trained to see and the mind to form independent judgments. The experiment in Boston was made with the children of the primary department in a private school, and was highly successful as far as it went. That the principles could be equally well applied to larger classes was proved in some of the public schools of Englewood, Ill., where they found enthusiastic adherents in many of the teachers.

The ideas underlying the experiment are explained in the second part of the book,

* An Experiment in Education, also the Ideas which Inspired it and were Inspired by it. By Mary R. Alling-Aber. New York: Harper & Brothers, 1897. Price, $1.25.

and are in sum that "children must at once be introduced to real knowledge, be given something worth their efforts, and treated as rational human beings, who ought not, even if they could, be made to greatly care for the symbols and shows of learning in the absence of the real substance, nor led to imagine that they were being mentally and morally nourished—that is, educated—when fed on chaff mainly." This part deals with the Quality of Studies, the Order of Studies, the Effects of Studies, and the Ends to be served by Studies—all with the view of producing a fully rounded, keen-eyed, alert, and self-dependent man or woman, able to do his share in the world's work, and to fill his place in the social order—in short, to attain to his highest development while fully sympathizing with the endeavors of his fellows. The doers of mankind are to be developed; the dreamers find no place in the author's scheme of education.

Part III gives some details about the teaching of special subjects, including Science, History, Literature, Language, Mathematics, Industrial Training, Means of Expression, and a chapter for mothers entitled At Home, indicating in what ways a mother may awaken her child's powers of observation. Part IV gives some suggestions about the atmosphere of the schoolroom. The experiment was made in 1881, when "natural-science studies had not been made an integral part of any primary schoolroom, and literature and history in such grades were mostly unthought of." Long strides in advance have of course been made in the sixteen years intervening; still, the book can not fail to arouse into more thoughtful activity many teachers, and it should especially appeal to mothers and to educators who advocate individual instruction. What may by some be considered an objection to the system is that it makes enormous demands on the ingenuity of the teacher, for in place of the routine of the schoolroom it puts individual thinking.

Mr. Moore's brief treatise on the *Philosophy of Art** is a thoughtful study, by a man who has had time and opportunity to give full attention to the subject from the literary rather than the evolutional point of view, of the origin and nature of the arts, which he classifies as those appealing to the sight and to the hearing. The author regards them all as primarily the outgrowth of necessity, and esteems as the most interesting feature of his inquiry the paradoxical nature of the transition from the original condition and purposes of art to its later and present uses.

A new work on geology, both suitable for a college text-book and very attractive to the general reader, has been written by Prof. *Scott*, of Princeton.* The author's plan has been to make a book dealing principally with American geology, after the style of Sir Archibald Geikie's Class-Book. Its American character is a marked feature of the present work. It is clearly advantageous, the author remarks, that we should make use of our own country in selecting typical facts for study. Accordingly, the formations that he describes and figures are nearly all American. Prof. Scott has had the use of a great deal of material collected for the United States Geological Survey, and a large part of his nearly three hundred figures are reproduced from photographs taken for the survey. Prof. Scott does not make much use of diagrams, evidently preferring to show the reader the actual appearance of the examples that may be seen in the field. The value of field study is strongly emphasized by him. Dynamical geology is the first of the large divisions of the subject that he considers, beginning with igneous agencies, but for students who begin a study of the subject in the fall he advises taking up other chapters first. He makes a special division of the work under the title Physiographical Geology, in which he has three chapters dealing with the changes in topography effected by geological agencies, and the clews which topographical features give in tracing past geological operations. A little more than one third of the work is devoted to historical or stratigraphical geology. Here, while both American and foreign formations and fossils are described, the foreign are always placed in a separate paragraph after the American,

* A Treatise on the Philosophy of Art. By D. R. Moore. St. John, N. B. Pp. 23.

* An Introduction to Geology. By William B. Scott. New York: The Macmillan Co. Pp. 573, 8vo. Price, $1.90.

with a distinctive heading. A table of the more important European formations is appended to the volume, but few of the subdivisions having been mentioned in the text. Another appendix contains the system of classification of the animals and plants which has been used in the book. There is a full index, and the mechanical execution of the volume is of a high order.

Prof. *Storer's* work on the chemistry of agriculture, which first appeared in 1887 and was revised in 1892, has been again revised.* It is based on the lectures which the author has delivered at the Bussey Institution, a department of Harvard University, now for twenty-five years. The chemical nature and behavior toward plants of every substance that has been used to any extent as a fertilizer are set forth in these volumes. Other subjects discussed are the relations of water to the soil, the effects of tillage, rotation of crops, the management of hay and grain crops, the production of ensilage, etc. The additions that have been made in this edition, and the fact that it has been entirely reset in larger type, have necessitated printing the work in three volumes instead of two as heretofore.

The second volume of Britton and Brown's *Illustrated Flora of the Northern United States*,† etc., gives the families, genera, and species from Portulaca to the dogwoods and tupelos, seventy-two families, in *Choripetalæ;* and from the clethras to Buckbean, sixteen families, in *Gamopetalæ*. We have already indicated, in our notice of the first volume of this work, its general character and scope. We have to refer specially here chiefly to the pains which are taken to make the work as a whole and the particular descriptions plain to the most untechnical reader. Every species is figured as to general habits, leaf, flower, and fruit; English names are given or the botanical names are translated into meaning English for each family, genus, and species; and English measures are used, so that the plain student may conceive at once and as if with his eyes shut the dimension indicated without having to look at a scale or make a mathematical reduction. Complete indexes are provided of English and of Latin names.

Mr. Thayer's essay on the *Hebrews in Egypt and their Exodus** is an attempt to find if there be not in the Pentateuch a reasonably credible, historic narrative which may be accepted with as much confidence as any other chapter of history so ancient. The argument is, in brief, that, owing to the strong race feeling of the Jews, the genealogies of their families were the most carefully recorded and the most uniformly coherent, consistent, and jealously preserved part of their history; that here we shall find firm ground to stand on, if anywhere; that the annals of the Pharaohs as now accepted by Egyptologists support and confirm these genealogies; and through these is to be traced the real thread of historic truth. While the author does not hold to the usually accepted views concerning the Pentateuch, he has no sympathy with what is called the destructive school of criticism. His argument is, on the contrary, intended to be constructive and preservative.

"A practical treatise for practical men" is what Dr. *Louis Bell* has aimed to make his recent book on *Electric Power Transmission* (Johnston Co., $2.50). After some discussion of elementary electrical principles and transmission of power by other than electrical means, he gives a chapter to power transmission by continuous currents, which up to the present time is the commoner mode. He then takes up the coming mode of power transmission, namely, by alternating currents. He points out the properties of alternating circuits that have a direct bearing on power transmission, and discusses monophase, polyphase, and heterophase systems and the forms of apparatus used with each. A chap-

* Agriculture in Some of its Relations with Chemistry. By F. H. Storer. In three volumes. Seventh edition, revised and enlarged. New York: Charles Scribner's Sons. Price, $5, *net*.

† An Illustrated Flora of the Northern United States, Canada, and the British Possessions, from Newfoundland to the Parallel of the Southern Boundary of Virginia, and from the Atlantic Ocean Northward to the 102d Meridian. By Nathaniel Lord Britton and the Hon. Addison Brown. Vol. II. Portulacaceæ to Menyanthaceæ. Portulaca to Buckbean. New York: Charles Scribner's Sons. Pp. 643. Price, $3.

* The Hebrews in Egypt and their Exodus. By Alexander Wheelock Thayer. Peoria, Ill.: E. S. Willcox. Pp. 315. Price, $1.25.

ter is given to apparatus for changing alternating to direct currents or the reverse. Dr. Bell goes outside the strict limits of his title to treat of steam engines and of the development and use of water power. The organization of a power station, line construction, and the various problems of distribution, including the commercial problem, are all discussed in more or less detail. The volume contains over two hundred diagrams and other illustrations, including several half-tone plates.

The Macmillan Company has issued for Dr. *Charles B. Davenport* the first part of a work on *Experimental Morphology*, to be completed in four parts. This part is devoted to the effects of chemical and physical agents upon protoplasm as determined by experiments. The chief chemical agents whose influence on the vital actions of protoplasm is examined are oxygen, hydrogen, oxides of carbon, ammonia, and various poisons. Among the physical agents experimented with are the forces heat, light, and electricity; the effects of moisture and dryness, of different densities of the containing solution, of molar agents, and of gravity are also passed in review. The influence of each agent on the direction of locomotion of the protoplasm is among the effects considered. Following each chapter is a list of literature on the subject of the chapter. The work is designed as a contribution to the fundamental question, Why does an organism develop as it does? Of the two classes of causes that influence development, Dr. Davenport has confined himself to the external causes. The three parts of the work to follow will deal respectively with growth, cell division, and differentiation. (Price, $2.60.)

The United States Geological Survey is publishing a geologic map of the United States with a topographic base map. It is being issued in parts, called folios, each covering a small area. Thus the *Yellowstone National Park Folio* contains four topographic sheets, known as the Gallatin, Canyon, Lake, and Shoshone sheets, and four geologic sheets of the same districts. The scale is about half an inch to a mile, and the contour interval is one hundred feet. Contours and elevations are printed in brown, water courses in blue, and the works of man, such as roads, railroads, and towns, are printed in black. The geologic formations are indicated by systematic coloring. There are also eleven photo-engravings of views in the region covered, and six folio pages of description. The plan of the map is explained on the two inside cover pages. The Survey has a circular telling the prices at which the several parts are sold.

An atlas of *Illustrations showing Condition of Fur-seal Rookeries in 1895 and Method of Killing Seals* has been printed as a Senate document to accompany the report of C. H. Townsend. It contains forty-six plates, many of them folded, the greater part of which are views on St. Paul and St. George Islands, showing the seals on the beaches. Six plates show the processes of killing and skinning the seals.

In the *Fourteenth Annual Report of the Bureau of Ethnology*, covering the year 1892–'93, the director, Major *J. W. Powell*, describes the work of the year, which included investigations along a number of distinct lines. The immediate purpose in organizing this bureau was "the discovery of the relations among the native American tribes, to the end that amicable groups might be gathered on reservations. It was early found that classification by somatologic (physical) characters was useless for the purpose in view, while a grouping by language, governmental institutions, religion, industries, and arts brought together tribes who could live in proximity with little or no strife. In general, language alone will serve as a satisfactory basis for this practical grouping, and readers familiar with the previous publications of the bureau have noticed the large share of attention that has been given to Indian languages, both spoken and written in pictograph. The present report is accompanied by three extended papers. One of these, on The Menomini Indians, by Dr. Walter J. Hoffman, describes the ritual of the Mitawit (Grand Medicine Society), into which he was duly initiated, and gives a considerable collection of Menomini mythology and folklore, together with descriptions of many of the arts and customs of this tribe and a vocabulary of its language. The memoir is illustrated with many full-page plates and smaller cuts. The re-

sults of a historical research appear in a paper on The Coronado Expedition, 1540–'42, by George P. Winship, of Harvard University. This expedition was sent out by Mendoza, Governor of "New Spain," in southern Mexico, and discovered the Pueblo Indians of New Mexico, the Grand Cañon of the Colorado, and the bison of the great plains. Mr. Winship presents the original text of Coronado's report and an English translation, together with translations of shorter papers relating to the expedition, and a historical introduction giving the events which led up to this undertaking and the circumstances under which it was carried out. Many reproductions of sixteenth-century maps and modern pictures of Pueblo Indians and their dwellings accompany the memoir. The ghost dance, which has been for half a dozen years a word to inspire terror in reports from the Indian reservations, is described by James Mooney in his paper on The Ghost-dance Religion and the Sioux Outbreak of 1890. The dance is the manifestation of an epidemic of religious frenzy which was transmitted from tribe to tribe over one third of the area of the United States and then died away. Mr. Mooney accompanies his account with descriptions of similar rites among the Indians and similar frenzies among Christians and Mohammedans. The memoir is copiously illustrated.

Nearly two thirds of the volume containing the *Report of the United States Commissioner of Fish and Fisheries for 1895* is devoted to a Check List of the Fishes and Fishlike Vertebrates of North and Middle America, by Jordan and Evermann. Owing to ill health, the late Commissioner McDonald was unable to prepare a report, and the work of the year is shown in the reports of assistants. Several special investigations are described in appended papers.

The statistical matter in the eighth annual report of the *Interstate Commerce Commission on the Statistics of Railways in the United States* follows the same order and covers the same ground as in previous years. It yields many evidences of continued business depression, although there has been a net decrease of twenty-three in the number of roads in the hands of receivers. Special features of this report are, first, comparisons not only with the preceding year, but so far as possible with the years from 1890 to 1894 inclusive; second, the compilation of operating expenses for 1894 and 1895; and, third, the table showing revenue and density of traffic for all roads whose gross revenue exceeds $3,000,000 a year.

The aim of Appletons' Home-Reading Books evidently is to give young persons a broader view of the world in which their lives are to be passed than they can get from their school books. It is not necessary that all knowledge should be gained by drudgery over set tasks; much may be imparted by books like these, which interest at the same time that they inform. In the little volume on *The Plant World* which he has prepared for this series, Mr. *Frank Vincent* has made an excellent collection of the romances and realities of the botanical kingdom. He has taken from the writings of American and foreign naturalists selections describing plants remarkable for their beauty, size, peculiar form, or great usefulness, and has scattered among them a few tributes from the poets. Mr. Vincent has not sought for the remote or startling alone. He calls upon Bonifas-Guizot to tell the uses of the cocoanut tree, and Paul Marcoy to describe the Victoria Regia, but he has also something about common grasses by Margaret Plues, and includes Whittier's poem on the pumpkin. Mr. Vincent has been in every quarter of the globe himself, and may be depended upon to select only accurate descriptions of foreign plants. Fifteen full-page photo-engravings add to the attractiveness of the volume. (Appletons, 60 cents, *net*.)

Prof. *Edward L. Nichols*, already favorably known as an author of text-books on physics, has produced an elementary work, under the title *The Outlines of Physics*, which is intended to be a fair equivalent for the year of advanced mathematics now required for entrance to many colleges (Macmillan, $1.40). In order to possess sufficient disciplinary value for this purpose, says the author, "physics must be taught by laboratory methods, and the experiments should be, as far as possible, of a quantitative nature." This book is designed as a text-book and a laboratory guide combined. "In the selec-

tion of the methods and of the apparatus used," Prof. Nichols continues, "I have always had in view the greatest possible directness and simplicity, rather than the highest degree of accuracy. The inexperience and the immaturity of the reader and the necessarily inadequate equipment of school laboratories have been likewise borne in mind." The applications of physics to the arts, which in some books are pointed to with pride, he has rigidly excluded. As in most elementary works, mechanics, being the simplest division of the science, comes first, and the chapter here includes something of hydrostatics and pneumatics. This is followed by heat; while electricity, often left till the last, comes third, being followed by sound and light. Practical directions on the use of apparatus are given in appendixes. Four hundred and fourteen cuts, nearly all from new drawings, illustrate the text.

The extraordinary activity in the determination of atomic weights since 1884, resulting in the accumulation of a great mass of new material, has led Prof. *F. W. Clarke* to prepare a revised and enlarged edition of his *Recalculation of the Atomic Weights*. It appears as Part V of the series of volumes on the constants of nature published by the Smithsonian Institution.

The small treatise on *Metals* in the Textbooks of Science Series, a new edition of which has been prepared by *A. K. Huntington* and *W. G. McMillan*, is based on one by Bloxam published in 1872, and rewritten by Prof. Huntington in 1882 (Longmans, $2.50). Its aim is "to make clear the principles which have guided the evolution of the metallurgical arts and industries, avoiding multiplicity of detail, which tends to obscure main issues." The volume opens with an extended chapter on the characters and modes of preparing the various fuels used in metallurgy, from charcoal to water gas. Several forms of apparatus for producing or utilizing various kinds of gas are also described. This chapter is followed by a few pages on refractory materials and fluxes. In passing to the treatment of the various metals, their common properties are set forth and certain general processes for crushing, dressing, and roasting ores are described. Because of its importance iron is given first place, and nearly two thirds as much space is devoted to it as to all other metals together. The chief ores of iron are described, and something is told of the Catalan and other primitive smelting methods. The various processes in present use for the production of iron and steel are then described, particular care being given to stating the reasons for each step, and to telling the properties of combinations of iron with small quantities of other elements. The other metals used in the arts are similarly treated. Among the less common ones to which a page or two is given are cadmium, iridium, palladium, bismuth, magnesium, and sodium. Tables and a full index are appended. There are one hundred and twenty-two cuts of furnaces and other apparatus.

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Fragments of Science.

A Bunsen Burner for Acetylene.—An interesting item regarding the use of acetylene as a heating agent occurs in the Chemical News. A. E. Munby writes: "The cheap production of calcium carbide has placed a powerful illuminant within the reach of those who possess no gas supply, but so far little has been heard of the use of acetylene as a heating agent. Our laboratory is, so far as we know, the first to make use of the gas for this purpose. We employ a Bunsen burner of special dimensions, the tube being five millimetres in internal diameter. A slightly wider tube may be used, provided the mouth be curved inward, so that the actual exit does not exceed the diameter mentioned; if larger, the flame tends to strike down. The gas jet is very small, being only capable of delivering about one cubic foot of acetylene per hour under six inches water pressure, such a rate of consumption giving an ordinary working flame. The air holes and collar are arranged as in an ordinary Bunsen, the exact size of the former not being of much importance, provided they be large enough to admit the air required. A generator capable of giving gas under seven inches water pressure with the full number of burners in use is required. The heating effect of the flame is, of course, very great, enabling one to dispense with the blowpipe for some operations, such as small fusions. . . . It would seem that in practice, for equal volumes burned, the acetylene has nearly twice the heating power of coal gas."

Officers of the American Association.—At the recent Detroit meeting of the American Association for the Advancement of Science, Prof. F. W. Putnam resigned the office

of Permanent Secretary, which he had held for about twenty-five years, and L. O. Howard, of the Department of Agriculture, Washington, was chosen to succeed him. The officers elect for the next meeting, which is to be held in Boston, are: President, Prof. F. W. Putnam; Vice-Presidents, Mathematics and Astronomy, E. E. Barnard; Physics, Frank P. Whitman; Chemistry, Edgar F. Smith; Mechanical Science and Engineering, M. E. Cooley; Geology and Geography, H. L. Fairchild; Zoölogy, A. S. Packard; Botany, W. F. Farlow; Anthropology, J. McKeen Cattell; Economic Science and Statistics, Archibald Blue (Toronto, Canada). The Sectional Secretaries are: Mathematics and Physics, Alexander Zirvet; Physics, E. B. Rosa; Chemistry, Charles Baskerville; Mechanical Science and Engineering, William S. Aldrich; Geology and Geography, Warren Upham; Zoölogy, C. W. Stilles; Botany, Erwin F. Smith; Anthropology, M. H. Saville; Economic Science and Statistics, Marcus Benjamin. D. S. Kellicott, Columbus, Ohio, was elected General Secretary, to succeed Prof. Hall; and Frederick Bedell, of Cornell University, was made Secretary of the Council.

The Age of the Earth.—In a recent lecture at the Victoria Institute on the Age of the Globe as an abode fitted for life, Lord Kelvin maintained that if heat had been uniformly conducted out of the earth at its present regular rate, the globe twenty thousand million years ago would have been a molten if not a gaseous mass. A further argument against the huge lengths of time required by the older geologists was sought in the constantly diminishing velocity in the earth's rotation resulting from tidal action. The earth was revolving faster a thousand million years ago than now, and consequently centrifugal action was greater. If the globe had become consolidated while it was traveling at a faster rate, it would have possessed greater oblateness and the length of the equatorial radius would have been six and a half kilometres more than it is. Judging from the properties of rocks and by underground temperatures, the date of the solidification of the earth was probably twenty or thirty million years ago. As to the origin of the atmosphere, at the time of solidification there could have been no free oxygen, so far as could be determined, and no chemical reaction by which it could be liberated. Vegetable life and sunlight must have come into play to prepare our atmosphere in the course of a few hundred or thousand years. A serious geological question was the mode of production of the ocean depths and of the eminences of the continents. Many phenomena were doubtless due to strain on cooling, but that did not afford a sufficient explanation in this case. The author thought the cause was change of density by crystallization. Perhaps the strongest argument against unlimited geological time was afforded by the heat of the sun, which may have illuminated the earth for somewhere about twenty million years. The latest geological estimate of the time required for the formation of all strata since the beginning of the Cambrian rocks was seventeen million years, and the author could hardly be spoken harshly of when he said that this earth could not have been a habitable globe for more than ten million years.

The Musée Social.—The *Musée Social* is a vigorous institution organized in Paris, in 1894, to furnish the public, besides information and discussions, with the documents, models, plans, and statutes of organizations and social institutions intended to ameliorate the material and moral situation of workingmen. It has established a permanent exhibition of social economy, a library of about nine thousand volumes, French and foreign, documents on important questions, and periodicals; and has made provision for communicating to those interested whatever information may be desired concerning social enterprises. For the collection of information it sends deputations to make personal observations of social facts, events, and institutions, and has correspondents abroad, of whom Mr. W. F. Willoughby, of the Department of Labor, represents the United States, to furnish news of the course of the social movements in their respective countries. The results of its inquiries are given to the public through stated conferences held at its rooms in Paris; through "circulars"—very respectable documents in size—published and distributed at short intervals, and through a series of publications known as

the *Bibliothèque*, or Library of the *Musée Social*. The Musée has been recognized by the state as of public utility, and its members and supporters are men of weight.

Some Conditions of Plant Distribution.—A paper published by Mr. Conway MacMillan in Minnesota Botanical Studies on the Distribution of Plants along Shore at Lake of the Woods is an admirable demonstration of the dependence over such an area as the shores of the lake of plant formations upon conditions of topography and the environment, is very minute and exhaustive, and is believed by the author to be the first of its kind published in America. From the multitude of illustrations it affords of the dependence of vegetal and other characteristics on small differences of conditions, we can take, almost at random, only a few. The shores of the lake are classified into front, mid, and back strands, etc. "The mid-strand area appears to afford an excellent example of the sensitiveness of plant formations to varying environmental conditions. The character and aspect, the abundance or paucity of certain forms, the arrangement of the different forms with reference to one another, all seem definitely related to the variations in exposure, slope, temperature, moisture, wind currents and surf impact, or upon combinations or modifications of these. So the constant variety of the beach as one walks along it is connected with the multitude of variations in the soil below, the air above, and the water off shore. The mid-strand, too, is modified by the back-strand which abuts upon it. . . . And by the physical texture and contour of the back-strand the mid-strand may be affected very sharply—as when the rain is carried through the gullies in the back-strand down upon or across the area nearer the water's edge. Curious interrupted patches of *Carices* and *Epilobiums* that occur in the mid-strand are often to be referred to declivities or gullies in the back-strand, directing the moisture to some spots rather than to others. Thus both the physical and biological conditions of the zone farther inland affect the beach flora quite as distinctly as do the conditions shoreward." The line between mid-strand and back-strand may be called a tension line, as between two general groups of plants striving to move in opposite directions, where a reciprocal stress is developed; and the plants of the mid-strand strive to enter the back strand, while the others try in turn to work out upon the mid-strand. Thus an irregular boundary line is developed, and the exact line of demarcation is nowhere altogether clear and distinct. A peculiar biological influence modifying back-strand at certain isolated points is the nesting of gulls and terns. "By their deposition of guano, and probably by their carrying in of seeds, these birds have at various points on island back-strand established conditions favorable to the development of vegetation islands that may mark the approximate spot of the rookery long after the birds have deserted it."

The Blue Color of Lakes.—It is generally agreed, as Carl Vogt demonstrated in an article published in the Monthly a few years ago, that pure water, as in many of the deepest lakes, is blue; and it is usually supposed that the greenish tint common to other waters is given to them by yellowish matter held in suspension, while an excess of such matter turns them yellow. The explanation, while he regards it as correct as to the color of water, is not accepted by M. W. Spring as sufficient to account for lakes looking blue; for, if their water is wholly pure and quiet, it will absorb the mass of the light, reflecting little or none, and look black. What gives this water its reflecting power? Some suppose the existence of colorless solid matter in the water like the dust that makes visible the diffused light of the atmosphere. That cause is admitted to be a possible one; but M. Spring has satisfied himself by experiments that water absolutely pure will also reflect the light if the mass is composed of layers of different temperatures that give rise to convection currents. This conclusion is supported by observation. Prof. F. A. Forel has found that fresh-water lakes are more transparent in winter than in summer, as they should be by M. Spring's theory; because in summer the differences in temperature between the surface and the layers beneath are greater. Thus the remains of the lake dwellers can be seen on the bottoms of the Swiss lakes in winter at places where they are not at all visible in summer. Prof. Forel thinks

that this is because there is more dust in them to obscure the view in summer than in winter; but there is no reason why this should be, while the disturbance by convection currents is necessarily much greater in the warm season. M. Spring does not interpret his theory as excluding any of the others, but as supplementing them.

At the Head Waters of the Niger.—In the expedition to the sources of the Niger, of which Colonel J. K. Trotter recently gave an account before the Royal Geographical Society, the first station of importance mentioned after leaving Freetown was Kruto, where the chief collected his people and organized a dance in honor of his visitors, himself leading and brandishing an elephant's tail. From a place called Kurubundo, reached several days afterward, there was no road farther on, and the chief set his people to work the whole night to cut a path to a village which the party reached the next day. Descending from the heights at the eastern limits of the British sphere to the Tembi, the travelers entered French territory. The guides here regarded their task as ended, and declined to point out the source of the Tembi, averring that it was the seat of the devil, whom they had no anxiety to meet, though they were devil-worshipers. They believed that any one who looked at the Niger source incurred the wrath of the devil and would die within the year, and they regarded the water as poisonous. Their views concerning the water seemed to be confirmed, but the agency of the devil was not made evident. A marked difference was observed in the aspect of the country in the river valley and outside of it. The part outside of the regular valley was covered with canebrakes ten feet high, yellow and sun-scorched. The moment the valley was reached the bush was green, the foliage abundant, and the trees were covered with creepers and trailers which constituted formidable obstacles. Such differences are characteristic of West Africa. The commission were disappointed at not finding the elevation of the Niger sources higher, 3,379 feet being the maximum recorded. The adjacent country was, however, distinctly mountainous, though none of the summits exceeded six thousand feet. The people in whose country this part of the journey lay exhibited a great love of music. The majority of them were pagans. Occasionally a Mussulman town was passed, and it was remarkable to observe how far the Mohammedans were in advance of the pagans in wealth, comparative civilization, and intelligence. The author regarded all the natives of the west coast, in spite of their defects, which are easily apparent and are in general those of a low order of civilization, as very tractable and quite ready to obey the direction of the Europeans. Their best point is their light-heartedness, which indeed he thinks is the bright spot of West Africa. It is a country where the worst jokes never fail to be appreciated, and where one is certain of bringing down the house without any claim to being a wit.

The Wastes of Civilization.—Improvident Civilization was the subject of the chairman's address by Prof. R. T. Colburn, in the Section of Social and Economic Science of the American Association. Touching the currency question, the speaker observed that when we speak of value, equivalency, wealth, risk, trust, distrust, panic, prosperity, we are dealing not with concrete substances like gold pieces, but with states of mind. Yet these ideas lie at the foundation of commercial exchanges and monetary science. "Have any of you ever imagined what would happen if some modern Rosicrucian should succeed in the turning of base metals cheaply into gold? . . . Such a discovery would introduce into the world of commerce, and indeed into all fiscal relations of men, an appalling confusion: first, by a general rise of prices; and, second, by a dislocation of fixed payments of interest, salaries, and otherwise. Among other curious results we should witness would be a change of sides and tunes between the advocates of the gold and silver standards. . . . The same thing would happen, only more slowly, if a vast deposit of gold were unearthed; and if, after gold was thus discredited by a practically inexhaustible supply, the attempt were made to put silver in its place (the price of which would be enormously enhanced), this state of things would be liable in its turn to be upset by similar discoveries." By precipitating the necessity of inventing some more efficient tool of exchanges, a scientific and more sta-

ble enumerator of values, the after benefits to mankind of such an event might compensate for all the disaster it would temporarily cost. The speaker declared our present civilization not abreast of the knowledge of the time and not yielding to mankind nearly the amount of comfort and well-being it might be made to do. As examples of its defects shown in the improvident tendencies of modern life, the speaker cited the waste of warfare and armament, the decadence of races, pernicious competition, spendthrift luxury, the blight of parasitism, the power of superstition, and the diversity of languages.

Legislation against Insects and Fungi.—Referring to the principles upon which legislation against insects and fungi injurious to vegetation rests, and recognizing that such laws are effective only to a limited extent, Garden and Forest suggests that "it does not follow that because the enforcement of a law is not certain it is therefore unwise to enact it. It is true that habitual disobedience to any law breeds to a certain extent contempt for all laws, but it is also true that the expression of the intelligence of a commonwealth on its statute book is of itself an educating force. Laws against forest fires, for instance, help to instruct people who have never given the subject attention as to the enormous amount of property fires sweep away. It has been estimated that a million and a half of dollars every day would not pay for the losses inflicted upon agriculture throughout the United States from insects and fungous diseases. . . . If we are not yet prepared to enforce wholesome laws to prevent this loss, we certainly ought to do everything possible toward creating a sentiment that will enforce them." The assumption on which these laws rest is defined to be that no man has a right to permit his premises to be a breeding ground for pests which will bring loss upon his neighbors when by due diligence he can prevent this. If the trouble does not come from his own carelessness, it is right that the state should pay him as it pays for the destruction of diseased cattle.

Vegetation of the Mammoth Cave.—Notes have been taken by R. Ellsworth Call, during frequent visits to the Mammoth Cave, of its flora; but the list, even including the molds and mildews found growing upon the remains of lunches taken in by parties, is a meager one. The plants are, of course, all cryptogams. Several of the forms occur in the greatest abundance in the region beyond the rivers of the cave, because, probably, many spores are introduced with the lunches. A small *Peziza* on very old, water-soaked timbers in the Mammoth Dome still persists in presenting reddish coloration, notwithstanding that the forms at present found must represent a generation quite remote from the one originally introduced. In some places the great white patches of *Mucor mucedo* are conspicuous by their size and great delicacy. Over the Bottomless Pit this fungus hangs down in long festoons of a white cottony consistence. In other places it runs wild over the soil surrounding decaying timbers. These forms are the most conspicuous in the wastes of the cave, but are often passed by, being mistaken for sheets or balls of white paper. Some of the forms of fungi are common to mines, where they grow under similar conditions to those prevailing in the Mammoth Cave. The constant temperature of the cave, 54°, is somewhat below that adapted to the abundant production of most forms of lower fungi.

Wreaths.—While the modern English limit the use of wreaths to funeral purposes, it was, as Mr. Talfourd Ely shows in his paper read before the Archæological Institute, among the ancients a sign of feasting and joy; and if their dead were crowned, it was to mark them as still partaking of the pleasures of this world. Religion originally prompted the use of the garland, which may have been connected with the widespread belief in the supernatural powers of trees and plants. Wreaths were employed as bandages to assuage headache resulting from debauch, and certain plants were believed to exercise a prophylactic power against the effects of wine. Floral decoration plays a great part in Greek poetry, while among the early Romans the use of wreaths in public was limited to religious functions and as marks of distinction connected with services performed to the state—a function largely derived from the Etruscans. In Greece the single wreath of olive, etc., as a reward for

athletes superseded the prizes of intrinsic value offered in heroic times. Wreaths of laurel, myrtle, vine leaves, or flowers, were commonly worn at symposia, and are thus represented on vases. A few such wreaths have been found preserved in Egypt. The manufacture of garlands is depicted in several Pompeiian pictures. Gold crowns were frequently modeled in the form of leaves. Other materials for wreaths were wool and artificial leaves and flowers of horn or silk. Much may be learned about wreaths in the writings of Theophrastus, Plutarch, Pliny, Athenæus, and Gellius, and from inscriptions.

Scenery of Spitzbergen.—Sir William M. Conway and his companions found Spitzbergen, of which they were the first explorers, a very different country from what it was supposed to be. The general impression was that a continuous ice cap would be found, and they expected it; but "in place of a frozen surface they met with crevassed sloppy glaciers, surrounded by miles of quaking bogs and innumerable watercourses"—a perpetual thaw produced by the perpetual day of a brief arctic summer, in a region emerging, as it were, from a glacial epoch. Of course, the opposite conditions of relentless ice prevail in winter. Why should men be attracted to such countries, as arctic explorers who have gone once seem to be time and again? Sir William gives one of the reasons. "The arctic glory," he says, "is a thing apart, wilder, rarer, and no less superb than the glory of any other region of this beautiful world. Here man has no place, and there is no sign of his handiwork. Nature completes her own intentions unhelped and unhindered by him. Such pure snows no Alpine height presents, nor such pale blue skies, nor that marvelous, remote, opalescent sea with its white flocks and its yet more distant shores. No Alpine outlook penetrates through such atmosphere, so mellow, so rich." There are days, the reviewer of Sir William's book in the Athenæum adds—rare days—of glorious cloud effects, when faint mists, delicate and gray, brood on the fiords and almost obliterate the bases of the hills, leaving their tops to stand out clear against a sky mottled with brilliant flocks of cloudlets. The beauties of Spitzbergen are found not as in true mountain regions in the forms of the hills, but in the atmospheric colors and effects. The landscapes have the charm of breadth, of horizontal lines, rather than any sublimity or picturesqueness. "The whole country," says Sir William, "is interesting from a scientific point of view because of the rapidity with which its surface is being modeled into such forms as were impressed in glacial times on the more temperate and inhabited parts of northern Europe."

Dancing Ostriches.—The execution of a kind of waltz is described by Mr. S. C. Cronright Schreiner as a common practice among ostriches. When there are a number of them, they will start off in the morning and, after running a few hundred yards, will stop, and with raised wings will whirl rapidly round till they are stupefied, or perhaps break a leg. The males pose also before fighting and to make their court. They kneel on their ankles, opening their wings, and balancing themselves alternately forward and backward or to one side or the other, while the neck is stretched on a level with the back and the head strikes the sides, now on the right, now on the left, while the feathers are bristling. The bird appears at this time so absorbed in its occupation as to forget all that is going on around him, and can be approached and caught. The male alone utters a cry, which sounds much like an effort to speak with the mouth shut tight. The omnivorous qualities of the ostrich have hardly been exaggerated. It swallows oranges, small turtles, fowls, kittens, and bones. Mr. Schreiner tells of one swallowing also a box of peaches, tennis balls, several yards of fencing wire, and half a dozen cartridges. One followed the workmen and picked up the wire as they cut it. Most frequently the ostrich does not swallow each dainty separately, but collects several in its throat and then swallows them all at once. Sometimes it is strangled. Its windpipe is then cut, the obstacle taken out, and the wound sewed up, when all goes well again.

Gypsum in Kansas.—The gypsum deposits of Kansas are described by Mr. G. P. Grimsley in the Kansas University Quarterly as occurring in a belt that trends northeast-southwest across the State, two hundred and thirty miles long, while the bed of exposed

rock increases in width from five miles at the north to thirty-six miles near the southern line. There are three chief areas with intermediate deposits. In the northern or Blue Rapids area the gypsum occurs as a gray, mottled rock, with sugary texture, covered at the top with a layer of white selenite needles forming satin spar, from one fourth of an inch to an inch and a quarter thick. The manufacture of plaster of Paris in Kansas was begun at this place in 1872, with an iron kettle holding about five barrels, heated by a stove. In the Gypsum City area, the lower portion of the bed is dotted with elliptical crystals of yellowish-brown selenite, nearly an inch long and half an inch wide, which give it an appearance somewhat like "bird's-eye limestone." Near Medicine Lodge the red clays and shales below the gypsum contain an interlacing network of selenite and satin-spar layers, which have been dissolved out of the solid stratum and carried down by circulating water. In the western part of the area solution has carved out caves and underground channels, leaving in many places natural bridges of gypsum. The rock is snowy white. Many of the plaster mills use earthy gypsum deposits, which are common, furnishing what is called "gypsum dirt." This is directly calcined, with small labor and expense. These beds, which lie in low, swampy ground, were probably formed by deposits from springs, aided by wash from the hillsides, and are recent. The rock gypsums were deposited in arms of the sea. Eleven mills are engaged in the manufacture of plaster.

Mythological Correspondences.—An attempt has been made by Dr. E. B. Tylor to use correspondence in culture as a means of tracing lines of connection and intercourse between ancient and modern peoples. Good evidence of this class is furnished by mythical beliefs notwithstanding their lack of objective value. The conception of weighing in a spiritual balance the judgment of the dead, first appearing in Egypt, is traced thence in a series of variants from Eastern Buddhism to Western Christendom. The associated doctrine of the Bridge of the Dead, which separates the good passing over from the wicked who fall into the abyss, of the ancient Persian religion, reaches likewise to the extremities of Asia and Europe. Historical ties are practically constituted by these mythical beliefs, which connect the great religions of the world and serve as lines along which their interdependence can be followed. Similar evidences exist of Asiatic influences under which the pre-Columbian civilization of America took shape. In the religion of old Mexico four great scenes in the journey of the soul in the land of the dead are mentioned by early Spanish writers, and are depicted in the Aztec Vatican Codex. They are the crossing of the river, the fearful passage of the soul between two mountains that clash together, the soul's climbing up the mountain set with sharp obsidian knives, and the dangers of the wind carrying such knives in its blast. These pictures correspond with scenes from Buddhist hells or purgatories as depicted on the Japanese temple scrolls. So close and complete analogies of Buddhist ideas in Mexico constitute a correspondence that precludes any explanation except direct transmission from one religion to another. All these and other analogies support the view that the natives of America reached their level of civilization.

A Versatile Man.—A remarkably versatile man, nearly equally eminent as a diplomatist, naturalist, and ethnologist, was Brian Houghton Hodgson, a British officer in the India service, who died in 1894, ninety-four years old. An attack of fever while he was studying at Calcutta sent him to the hill country of Kumaon, where as assessor of the little farms he had to traverse precipitous mountain paths, crossing dangerous rivers with the help of men swimming on gourds or by bridges which were only ladders suspended from cables, became friends with the people, and imbibed a taste for natural history. Next, as assistant in Nepaul, he began the collections of manuscripts, texts, and religious tracts with which he endowed the libraries of Europe and Asia, hunting them up in the archives of Buddhist monasteries and buying them from traffickers and monks. The Buddhist collections of seven of the most famous Orientalist libraries began with these gifts, and Eugène Burnouf, who was indebted to one of these collections for the materials of his great work on the History of Buddhism,

said that he collected a larger body of original documents than had up to that time been gathered in either Asia or Europe. He first brought the Thibetan classics within the range of the Indian and European scholar, presenting the libraries with two copies of the collection of three hundred and forty-five folios, one of which was a gift to him from the Grand Lama. His published essays corrected the misinformation and dissipated the fantastic theories that had prevailed on these subjects. Retiring from active service, he went to Darjeeling and engaged in the study of Himalayan natural history. He discovered thirty-nine new genera and species, contributed "a vast number of papers on Himalayan mammals, raised himself . . . to the highest rank among the original ornithologists of the day," and presented collections to a number of societies and museums. An expert is quoted as saying that "in some respects he was in advance of the science of the day. He was fully alive to the importance of geographical distribution, and was the first to attempt a demarcation of the zones of life resulting from differences of elevation in the Himalayas."

MINOR PARAGRAPHS.

A CURIOUS plant is the wild tamarind, or jumbai plant (*Leucæna glauca*), of the river sides and waste places of tropical America; and very strange are its effects upon the non-ruminant animals that feed upon its young shoots, leaves, pods, and seeds, as described in the British Association by Mr. D. Morris, of Kew Gardens. It causes horses to lose the hair from their manes and tails, has a similar effect upon mules and donkeys, and reduces pigs to complete nakedness. Horses are said to recover when fed exclusively on corn and grass, but the new hair is of different color and texture from the old, so that the animal is never quite the same as it was. One instance is cited in which the animal lost its hoofs too, and had to be kept in slings till they grew again and hardened. Ruminant animals are not thus affected, and the growth of the plant is actually encouraged in the Bahamas as a fodder plant for cattle, sheep, and goats. The difference in its action upon ruminants and non-ruminants is probably due to changes effected upon it in the chewing of the cud.

AMONG the events mentioned in the thirtieth report of the Peabody Museum of American Archæology and Ethnology is the completion of the arrangement of the Mary Hemenway collection in such a way that a nearly complete exhibition of the archæology and ethnology of the Pueblo peoples of our Southwest is presented in the upper hall and the gallery on the floor below. Mr. Valk's explorations in New Jersey, enforced by the observations of Prof. G. F. Wright, are mentioned as confirming the opinion that stones worked by man are found in the glacial deposits of the Delaware Valley. Valuable relics have been obtained from the prehistoric sites of Mount Kineo and from the Indians of Maine. Mr. Gordon has examined deposits in Honduras attesting a mixture of several types of culture, and has obtained many objects of interest from the exploration of two caves. His general report on the ruins of Copan, already noticed in the Monthly, is a publication of very great value. Many contributions of literature and specimens, all deserving fuller notices than we can give them, are acknowledged in the report.

PHYSIOLOGICAL experiments are of various kinds, and while some are of such a character as to suggest cruelty unless performed under the most careful guards, there are probably others to which animals may be indifferent, or which may be even agreeable to them. Of the last seems to be one described by Dr. E. A. de Schweinitz in a recent address before the Chemical Society of Washington. "A fine blooded horse, not available for ordinary use on account of his propensity to run away, was converted into a subject for the cultivation of the tuberculin antitoxine. He was, of course, expected to rebel; but, on the contrary, he received the hypodermic injection of the poison of the tuberculosis germ in quietness and even seemed interested in watching the operation. As a burned child dreads the fire, it was supposed he would resist the second operation. But as soon as he observed the doctor appear with the syringe and bottle, he trotted to-

ward him with pleasure, stood quietly looking around with intelligence while the injection was made, and ever afterward lent himself to the experiment with as much evident pleasure and interest as that of the investigators."

EXPERIMENTS made by Asa S. Kinney at the Hatch Experiment Station, Massachusetts, with special reference to that question, prove that electricity exercises an appreciable influence on the germination of seeds, and that the application of certain strengths of current for short periods of time accelerates the process. The range in the strength of current which accelerates germination is exceedingly limited, and within this range there are a maximum, optimum, and minimum current. Seeds subjected to but one application of electricity show the effect only for a few hours, while, when applied hourly to germinating seeds or growing plants, electricity does not lose its effect, but acts as a constant stimulant to their growth and development.

THE movement for instruction in domestic science is finding increasing favor. Provision is gradually being made for it as the demand extends in one institution after another. It is recognized in the Ohio State University in the name of the College of Agriculture and Domestic Science, where a "short course" and a four-year course in the branch are arranged for. The programme of the department, which is under the direction of Miss Perla G. Bowman, of the Toledo Manual Training School, includes cookery in its various branches, with the principles of combustion, food economics, the chemistry of the human body, comparative nutritive and money values of foods, invalid cookery, a waiting course, household economics, the properties of textile materials, sewing, millinery, costumes, dressmaking, and needlework. In connection with these last topics, the choice and treatment of various materials, line, form, color, and texture, as applied to dressmaking, are illustrated in connection with practice. In designing the courses, the need of every woman for the most liberal culture in connection with technical training has been recognized.

AN exhibition at the Archæological Institute of England of prehistoric flint implements, discovered in Egypt by Mr. H. W. Seton Karr, includes articles from the mines of the Wady-el-Sheik district, in the Eastern Desert, some of the types of which are new to science, and implements from Abydos, Nagada, Nagh Hamdi, Thebes, and other places in the Western Desert. At some of the mines are shafts about two feet in diameter filled up with drifted sand and surrounded by masses of excavated earth neatly arranged. There was usually a central place where most of the objects were discovered. At some mines a number of clubs or truncheons lay distributed uniformly when the mines were abandoned. Other implements of flint and quartzite are from Somaliland, and were found on a long, low hill about a hundred miles from the coast. The country around was of limestone, in some places overflowed by lava, and the implements lay in ones, twos, and threes. Sir John Evans said, in a communication to the Royal Society, that these discoveries "have an important bearing on the question of the original home of the human race. Of their identity in form with some from the valley of the Somme there can be no doubt, and we need not hesitate in claiming them as palæolithic."

NOTES.

THE Columbia University Bulletin notices the retirement, at his own request, of Prof. Thomas Egleston, of the Faculty of Applied Science, the creator of the original School of Mines, of which the faculties of Applied Science have been the outgrowth. Returning from his studies abroad in 1863, he saw that the time was ripe for a school in which chemistry, geology, mineralogy, metallurgy, and engineering might be taught young men with a view to fitting them for practice in the field of mining. The success of the School of Mines was surprising and encouraging. The demand for instruction in allied branches was so great that schools of architecture and engineering and chemistry, etc., were formed and set off in 1896 in the Faculty of Applied Science. What has been done at Columbia has happened to a greater or less extent at several other institutions, so that schools and departments of this sort are multiplying.

THE ascent of Mount St. Elias, Alaska, was successfully accomplished by Prince Luigi, of Savoy, and his party of Italian mountain climbers, July 31st. On their way up they met the American party led by Mr. Bryant, who were returning on account of

one of their number having been taken ill. The Italians remained two hours on the summit, and took scientific observations and photographs. The height of the mountain was for the first time satisfactorily measured and found to be 18,120 feet. In the previous attempts to ascend this mountain the Topham expedition reached a height of 11,400 feet, and Prof. I. C. Russell, in the second attempt, made under the auspices of the National Geographical Society in 1891, 14,500 feet. Prince Luigi found nothing to indicate that the mountain had ever been a volcano.

THE vessel Evelyn Baldwin arrived at Christiania, Norway, August 13th, from Spitzbergen, whence she had sailed northward to 80° 45′ of latitude and until stopped by pack ice. The expedition has secured valuable geological and botanical collections for some American colleges.

PROF. S. P. LANGLEY, Secretary of the Smithsonian Institution, recently attended a meeting of the French Academy of Sciences, and spoke concerning his experiments in mechanical flight. He said he had greatly enlarged the distance which his aëroplanes would run, without much changing his apparatus.

PROF. WOLCOTT GIBBS, who had been designated president, was not able to be present at the Detroit meeting of the American Association for the Advancement of Science, and Mr. W J McGee took his place as acting president.

A REPORT by Dr. Lambusto Loria on war customs of certain tribes of New Guinea mentions homicide and the "naming of the dead relatives of others" as the two great causes of intertribal war. Homicide is the result of various savage ideas. After a death, "all the gardens and plantations of cocoanuts and betel nuts, etc., belonging to the murdered person are destroyed, to allow the relatives and friends to forget quickly the departed person." Revenge is then decided upon, and preparation is made for it with curious preliminary religious rites.

IN a paper in the American Association on the Destruction of Forests and its Effects on Drainage and Agriculture, Mr. H. W. De Courcy advised the farmer. Let him but follow the lines of least grade in his tillage, and "he will soon see the effect of his improved line of cultivation in better crops, greater resistance to droughts by retaining the drainage water, and his young plantations of trees will gladden his sight on the former bare hillside." A safe guide to the line of least grade is the course of a railroad, if there be one through the farm, which always seeks that line.

THE French Association for the Advancement of the Sciences recently held its meeting at St. Étienne, and was opened with an address by the president, M. Marey, on The Graphic Method and the Experimental Sciences. The review of the past year's work of the association, read by M. Cartaz, includes notices of studies during the interim of historical geography; of legislation for workingmen, by M. Lebon; of alcoholism, by M. Alglave; a memoir of Pasteur, by M. Brouardel; and a work on bibliography, by Prof. Charles Richet. The death list is rather large, and includes, among the best-known names, those of D'Abbadie, Daubrée, Des Cloiseaux, Schutzenberger, Léon Say, Cernuschi, and Victor Lemoin, physician and geologist.

THE Hon. Ralph Abercromby, author of some excellent works on meteorology, including that on Weather in the International Scientific Series, died at Sydney, New South Wales, June 21st, fifty-four years of age.

THE death was announced in July of J. J. S. Steenstrup, ex-Professor of Zoölogy and Director of the Zoölogical Museum in Copenhagen, aged eighty-four years. His studies and his books covered a wide field. His principal work was that on the Alternation of Generations. Besides publishing much on natural history, he studied the prehistoric remains found in Denmark, and in conjunction with Sir John Lubbock contributed, in 1866, to the Ethnological Society of London a memoir on the Flint Instruments recently discovered at Persigny-le-Grand.

PROF. THIERRY WILHELM PREYER, formerly of Jena, died in Wiesbaden in July, fifty-six years of age, of Bright's disease. He was distinguished in physiology and psychology. He was born in Manchester, England, in 1841, was taught in London, attended several German universities, and took his degrees at Bonn in 1862 and 1865. He began scientific life as a privat docent at Bonn in 1865, and was appointed Professor of Physiology at Jena at 1869. He retired from this position a few years ago, and went to Berlin and then to Wiesbaden. He was author of a famous work on hæmoglobin; published researches on the mental development of the child, some of which appeared in The Popular Science Monthly, and some form a volume in Appletons' International Education Series; carried on researches in acoustics; investigated the cause of sleep, and published observations on hypnotism; and was the author of Elements of General Physiology.

THE distinguished chemist, Prof. Victor Meyer, died at Heidelberg, August 8th. He was born in Berlin in 1848, and was professor successively at Stuttgart, Zurich, Göttingen, and Heidelberg; was author of numerous original researches in organic chemistry, and also contributed to chemical physics, especially in the field of vapor densities.

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APPLETONS' POPULAR SCIENCE MONTHLY.

OCTOBER, 1897.

EDITED BY WILLIAM JAY YOUMANS.

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NEW YORK:
D. APPLETON AND COMPANY,
72 FIFTH AVENUE.

SINGLE NUMBER, 50 CENTS. YEARLY SUBSCRIPTION, $5.00.

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Entered at the Post Office at New York, and admitted for transmission through the mails at second-class rates.

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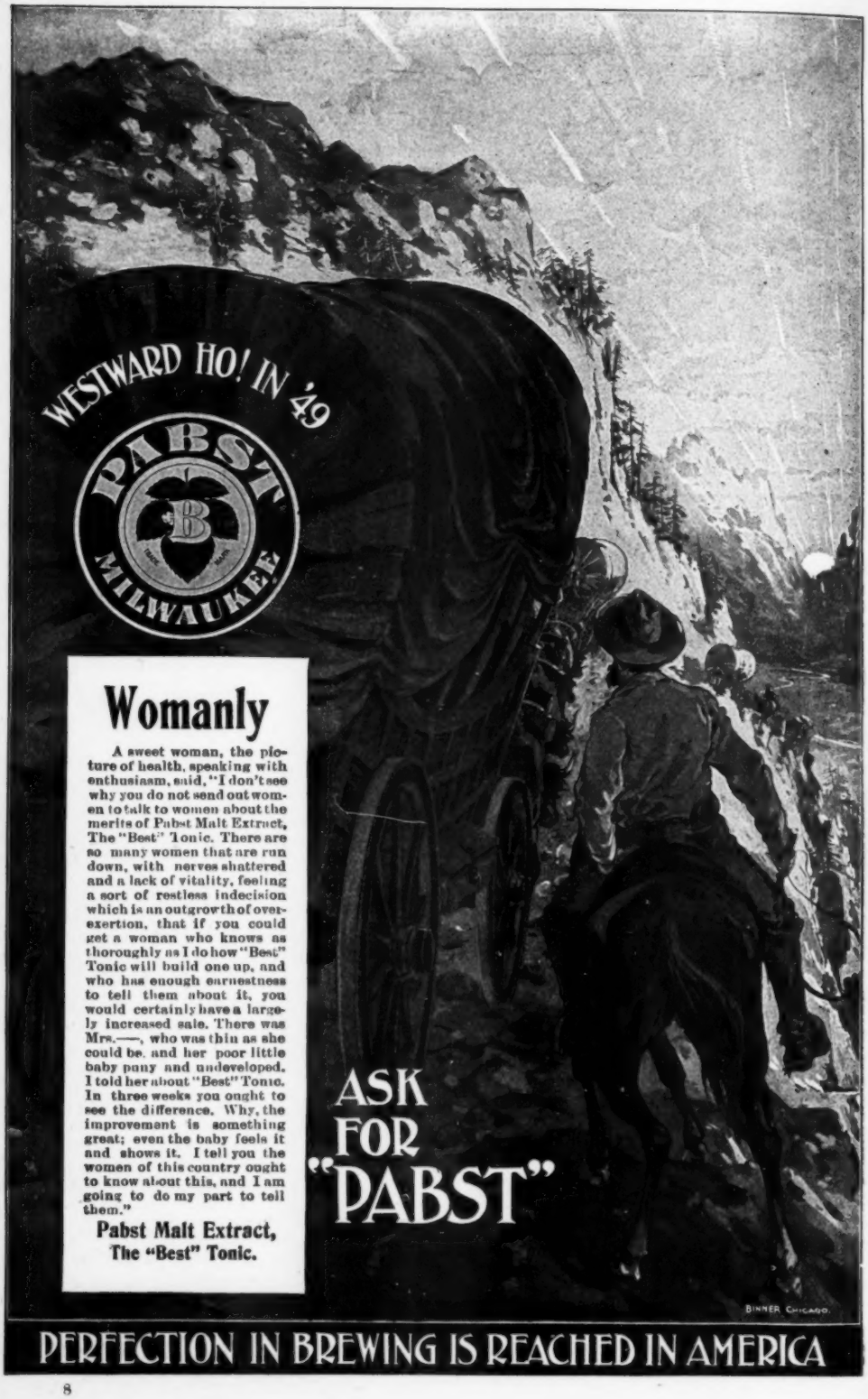
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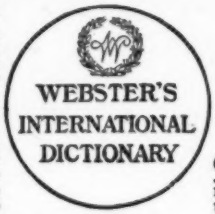

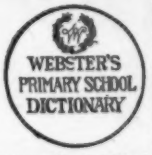

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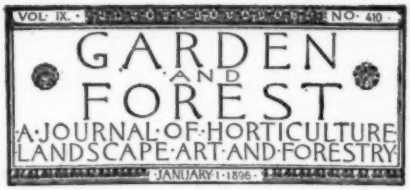

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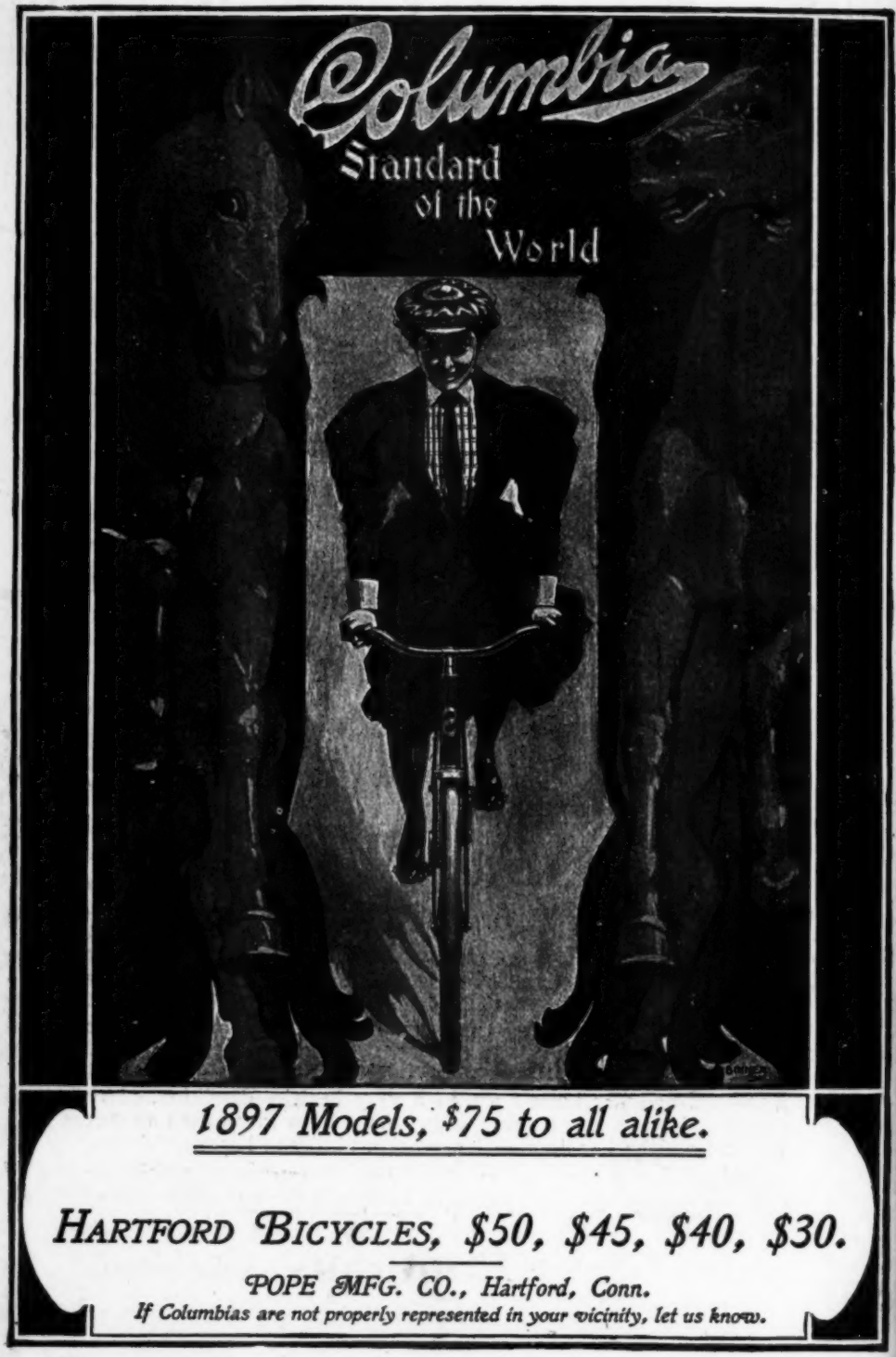

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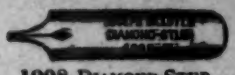

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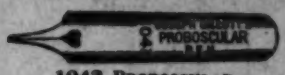

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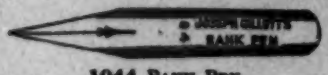

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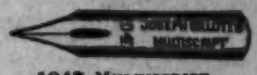

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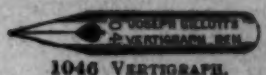

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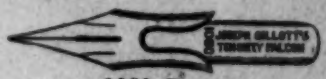

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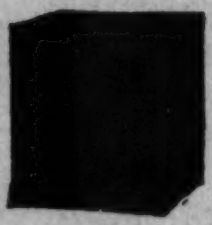

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